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Matsuo et al.

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[54] **AUTOMATIC DOCUMENT CONVEYING APPARATUS**

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[21] Appl. No.: **76,867**

[22] Filed: **Jun. 15, 1993**

[30] **Foreign Application Priority Data**

Jun. 16, 1992 [JP] Japan 4-156379

[51] **Int. Cl.**[6] **G03G 15/00**

[52] **U.S. Cl.** **355/308;** 271/4; 355/313

[58] **Field of Search** 355/308, 309, 311, 313, 355/314, 317, 203, 204, 209, 208; 271/3.1, 8, 9, 10, 4, 3, 18; 226/1, 27, 28

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Primary Examiner—A. T. Grimley
Assistant Examiner—Thu A. Dang
Attorney, Agent, or Firm—Antonelli, Terry, Stout & Kraus

[57] **ABSTRACT**

An automatic document conveying apparatus in which a normal continuous document conveying state and a single document conveying state, suitable for a document having high importance such as an original of a design, can be selectively determined, and carrying and discharging of documents can be fully well conducted. In a document carrying passage, a restricting member and a separation roller which cooperate with a feed roller are disposed. The forward end of the restricting member approaches or contacts the feed roller, and the separation roller is driven to rotate in a direction opposite to the document conveying direction in the continuous document conveying state. In the single document conveying state, the restricting member is isolated from the feed roller, and the separation roller can be freely rotated.

33 Claims, 14 Drawing Sheets

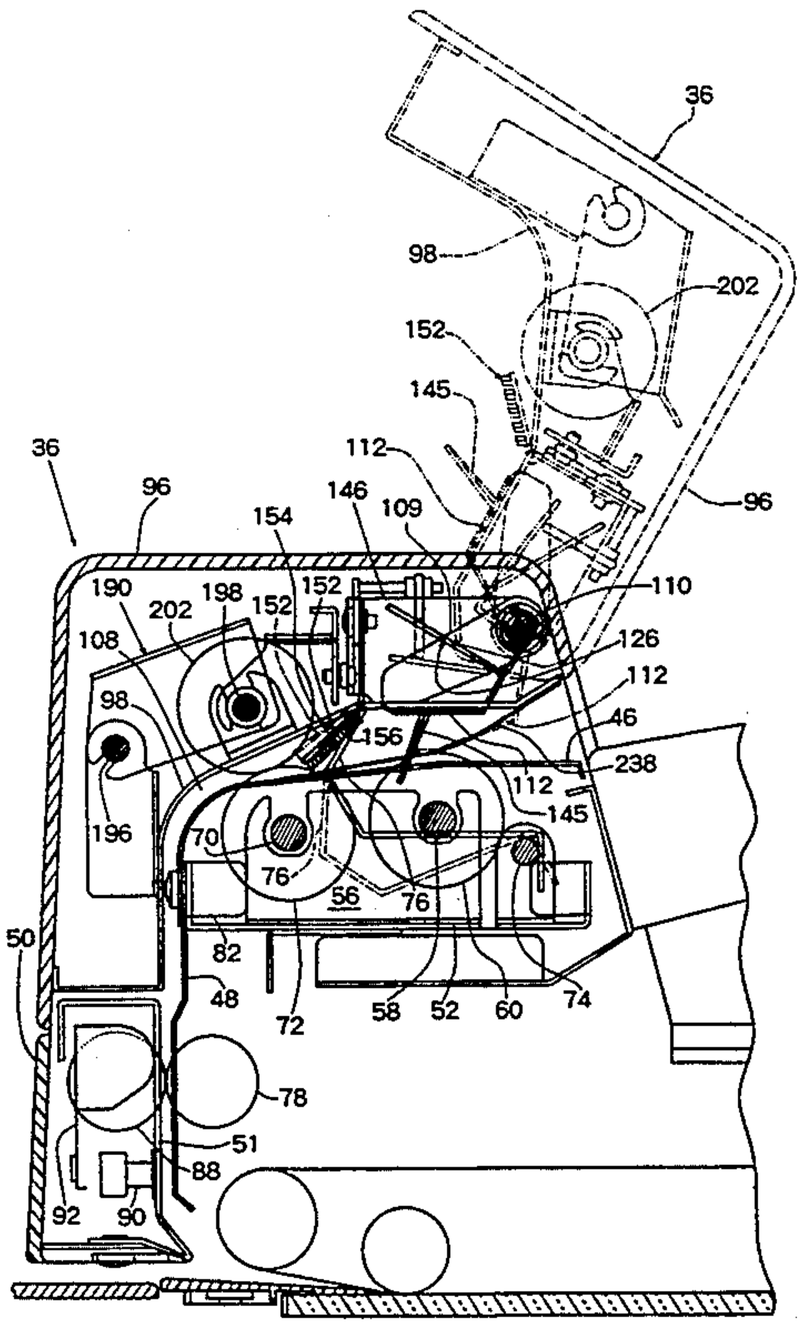


Fig. 1

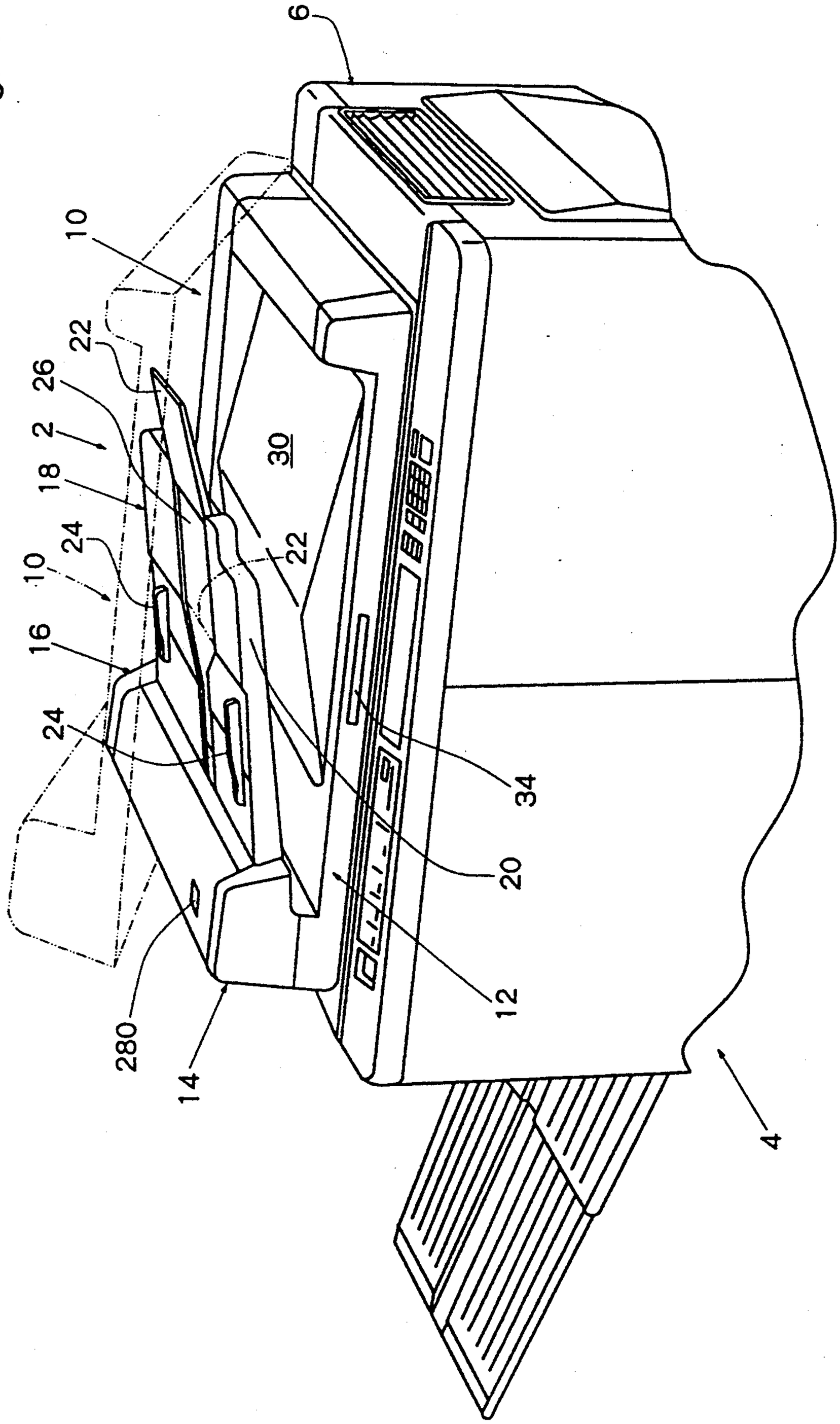
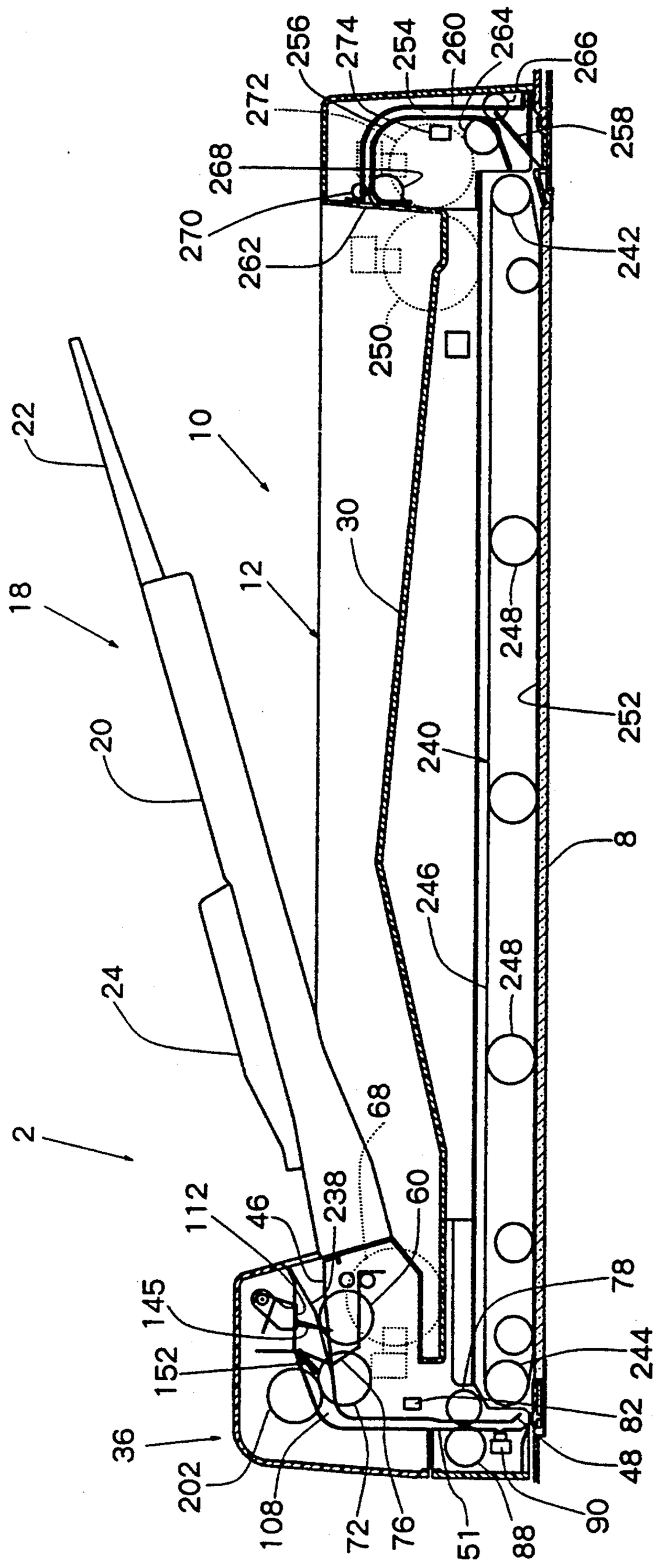


Fig. 2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246
24
8
68
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202
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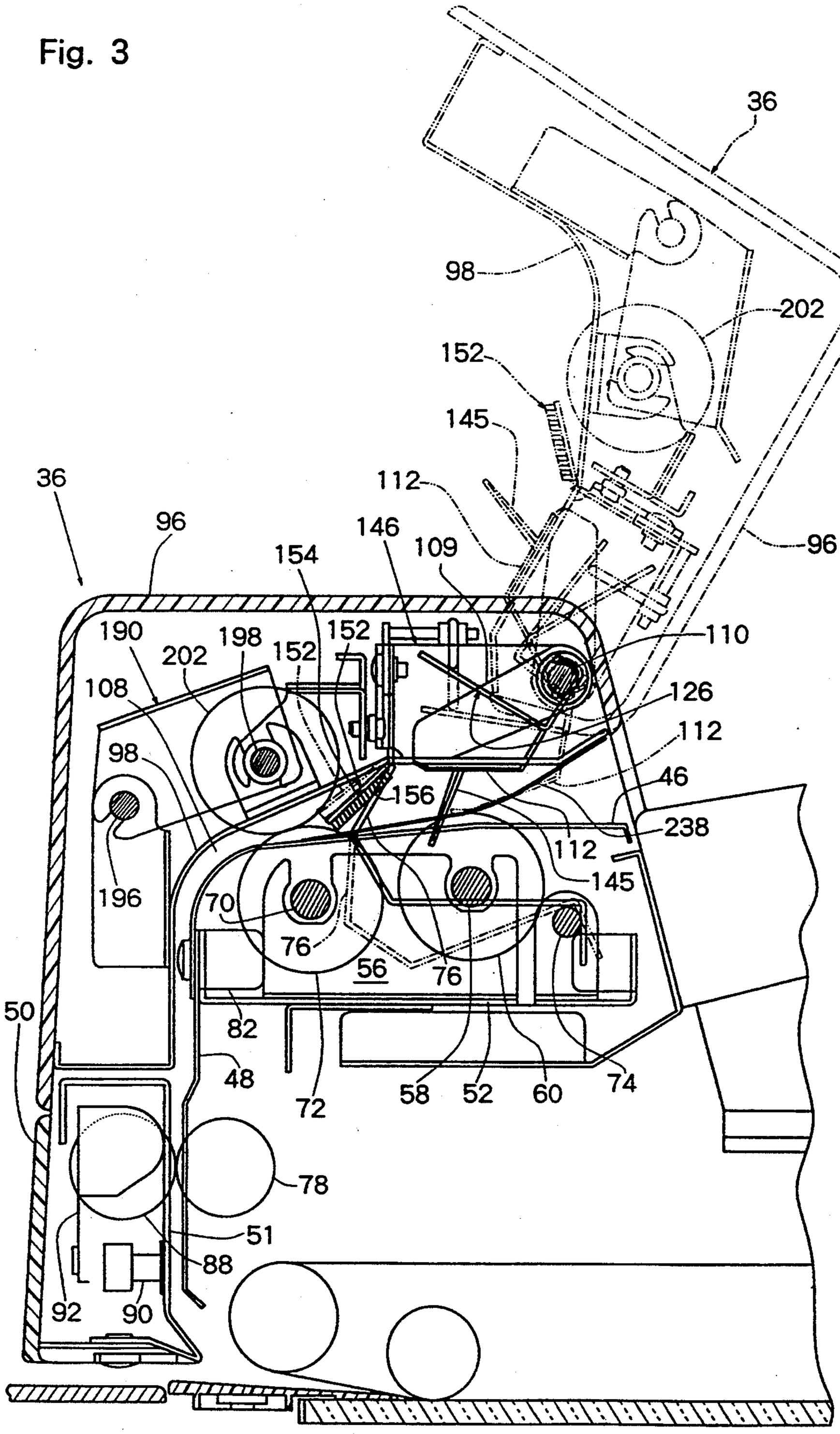
108
72
76
51
88
90

Fig. 3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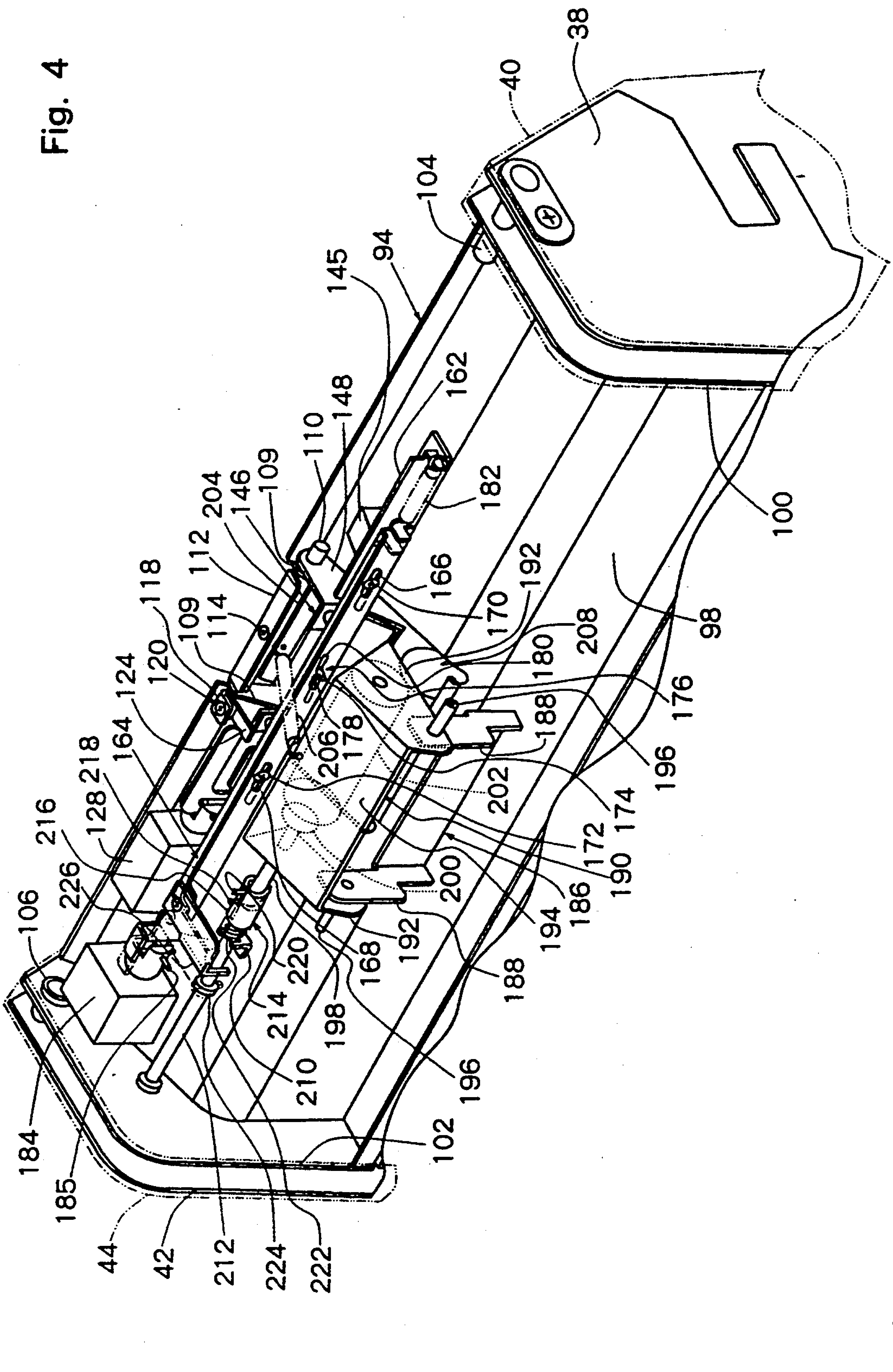
92
90

Fig. 4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226
106
182
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192
170
208
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100
176
188
196
206
178
202
174
172
190
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212
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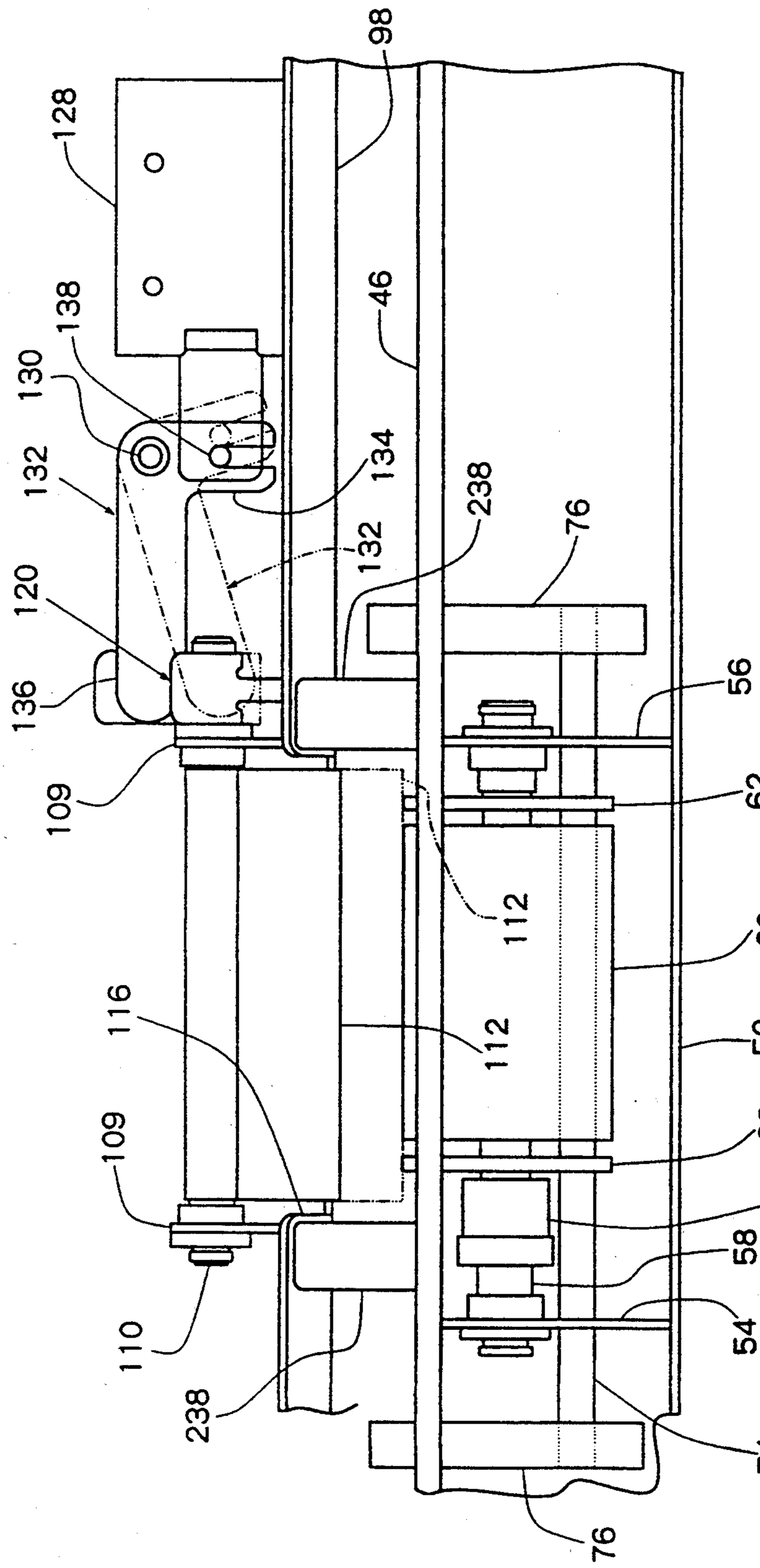
222

Fig. 5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74
76

Fig. 6

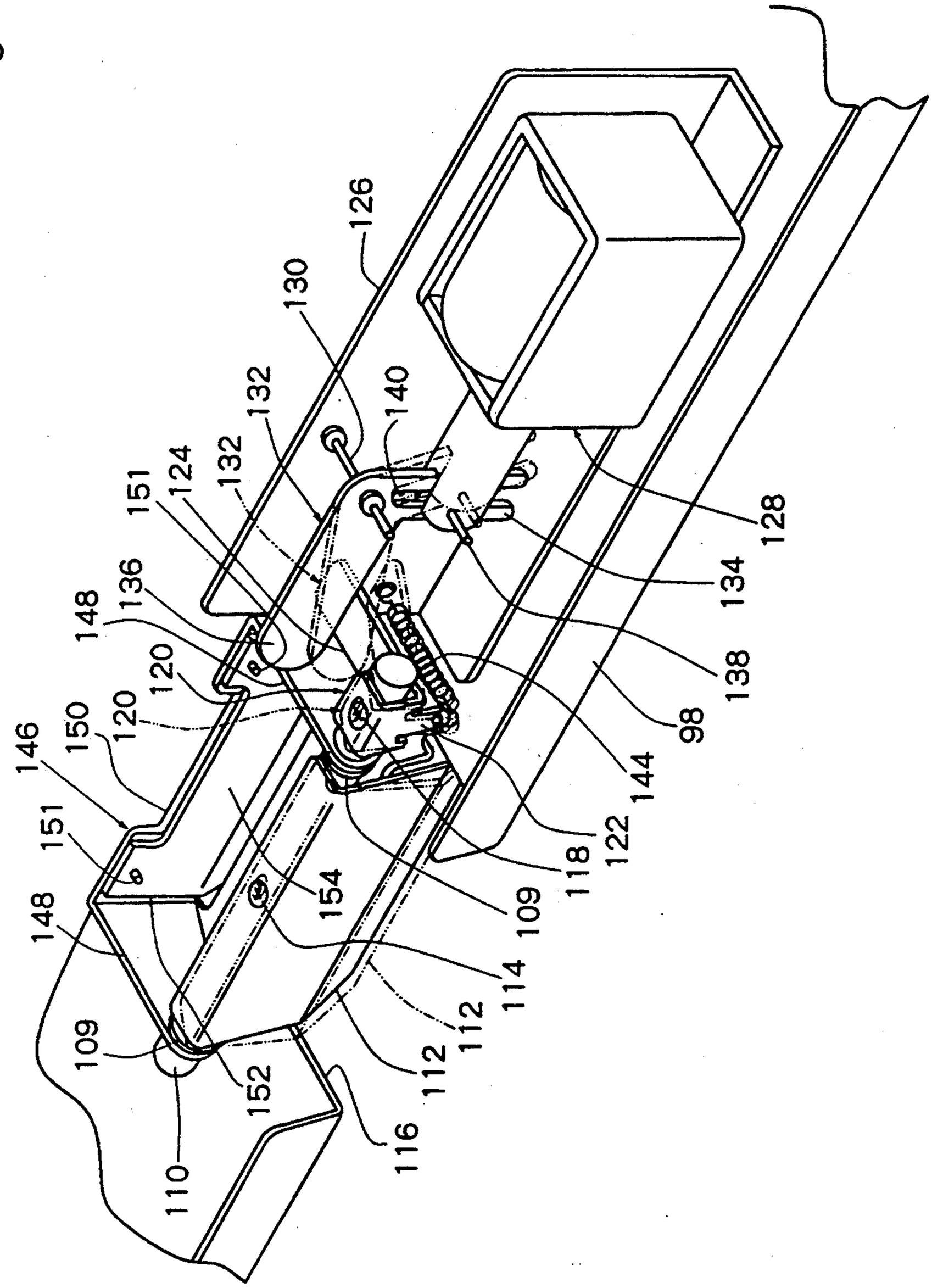
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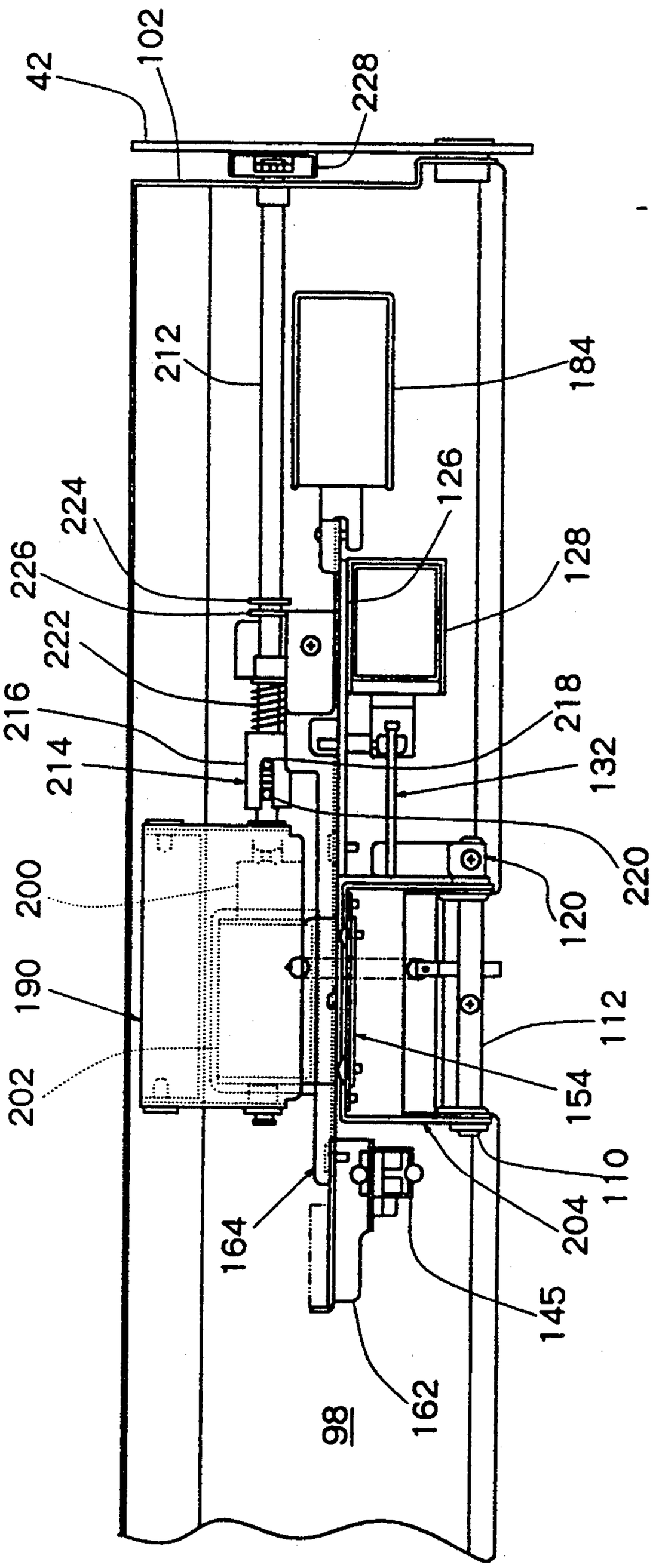
Fig. 7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98
162

Fig. 8

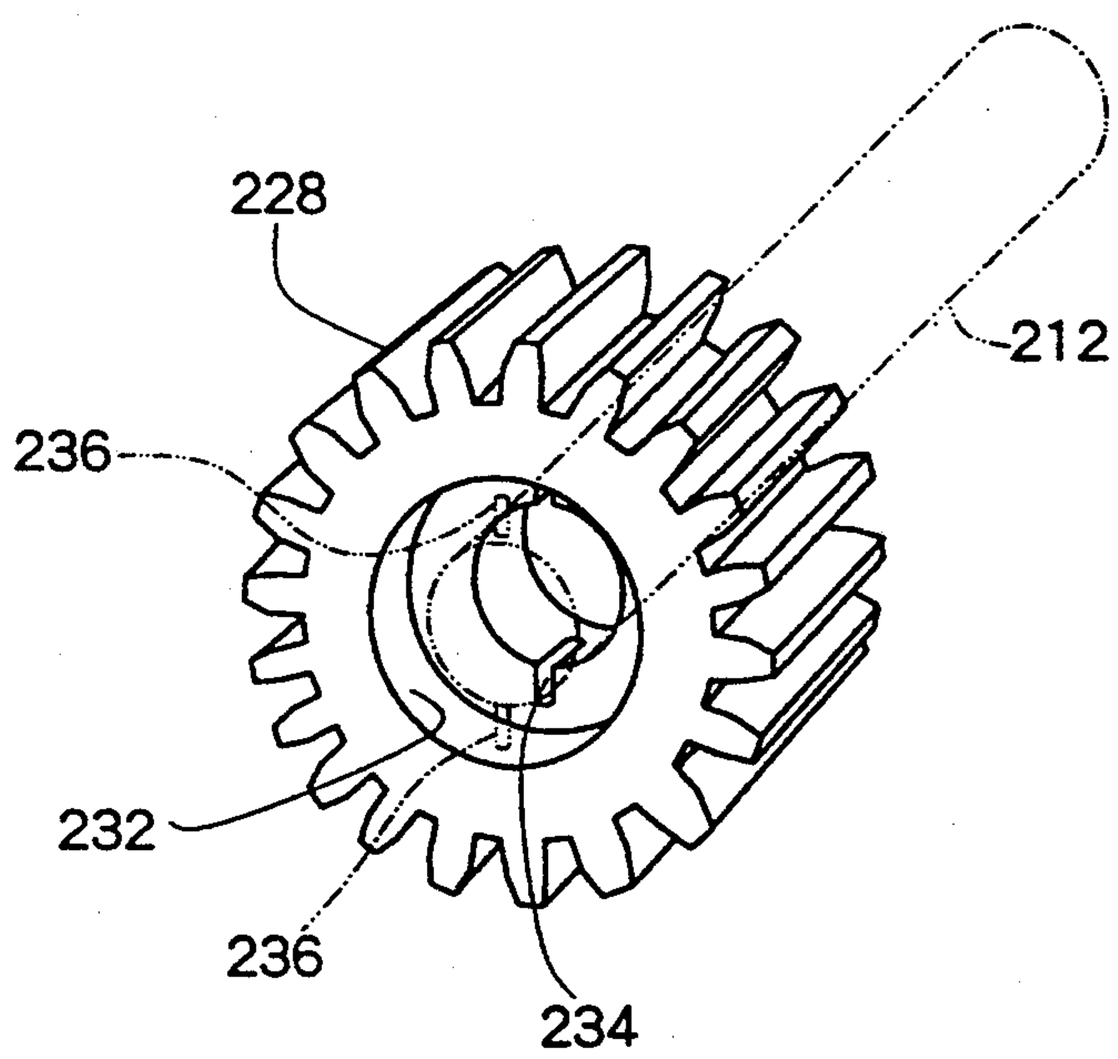


Fig. 9

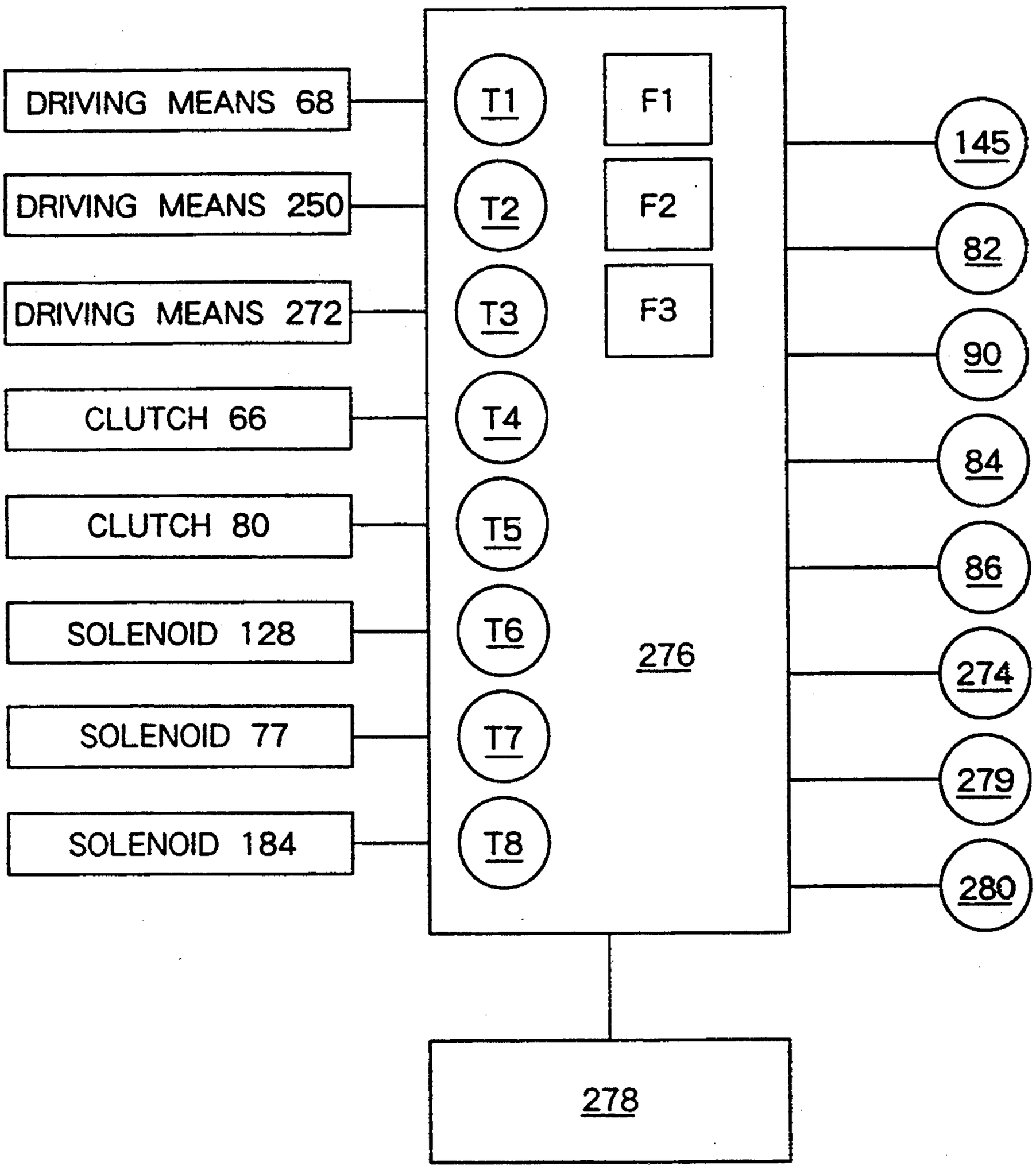

DRIVING MEANS 68
DRIVING MEANS 250
DRIVING MEANS 272
CLUTCH 66
CLUTCH 80
SOLENOID 128
SOLENOID 77
SOLENOID 184
T1
T2
T3
T4
T5
T6
T7
T8
F1
F2
F3
276
145
82
90
84
86
274
279
280
278

Fig. 10

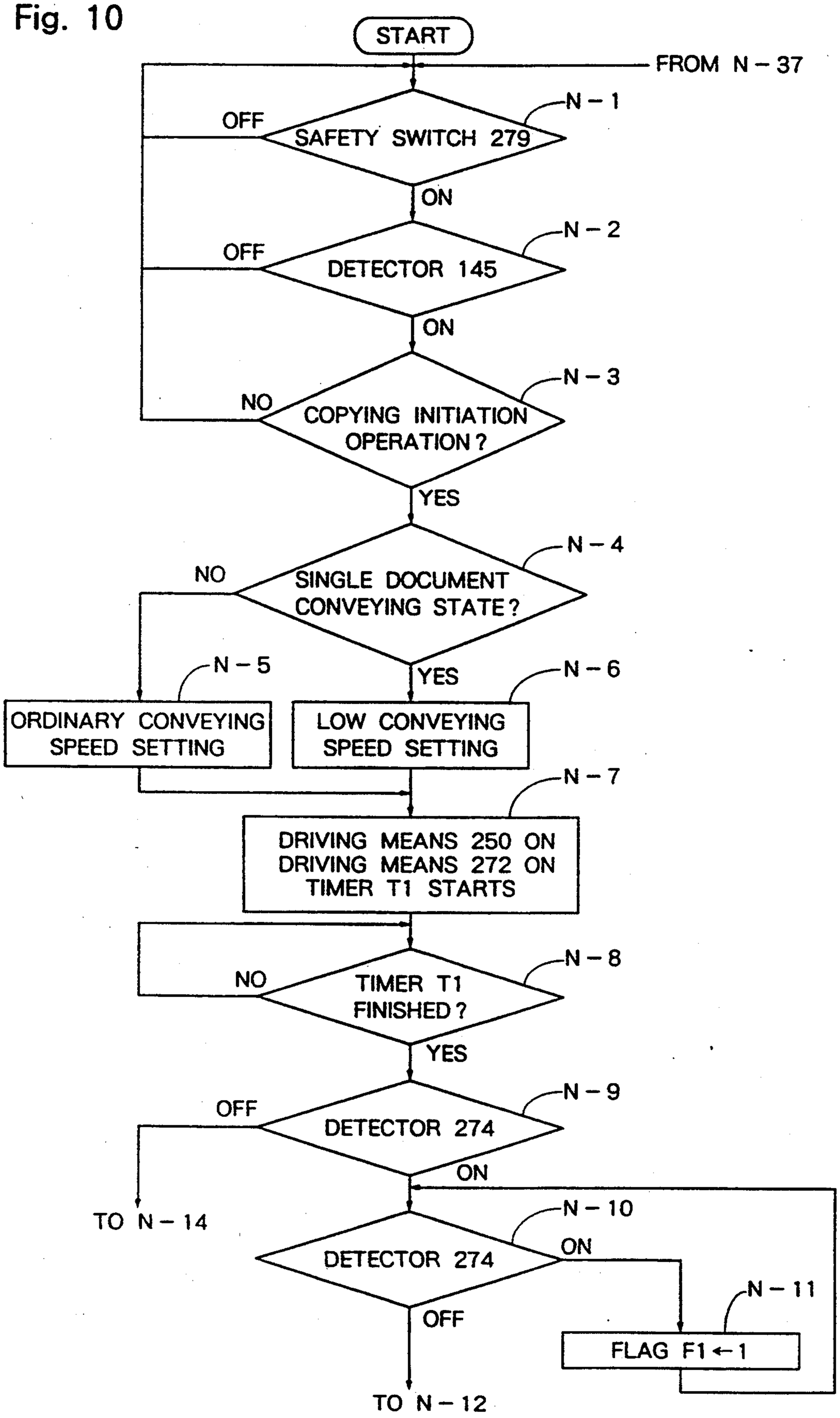

START
FROM N – 37
N – 1
OFF
SAFETY SWITCH 279
ON
N – 2
OFF
DETECTOR 145
ON
N – 3
NO
COPYING INITIATION OPERATION?
YES
N – 4
NO
SINGLE DOCUMENT CONVEYING STATE?
N – 5
YES
N – 6
ORDINARY CONVEYING SPEED SETTING
LOW CONVEYING SPEED SETTING
N – 7
DRIVING MEANS 250 ON
DRIVING MEANS 272 ON
TIMER T1 STARTS
N – 8
NO
TIMER T1 FINISHED?
YES
N – 9
OFF
DETECTOR 274
ON
TO N – 14
N – 10
ON
DETECTOR 274
N – 11
OFF
FLAG F1 ← 1
TO N – 12

Fig. 11

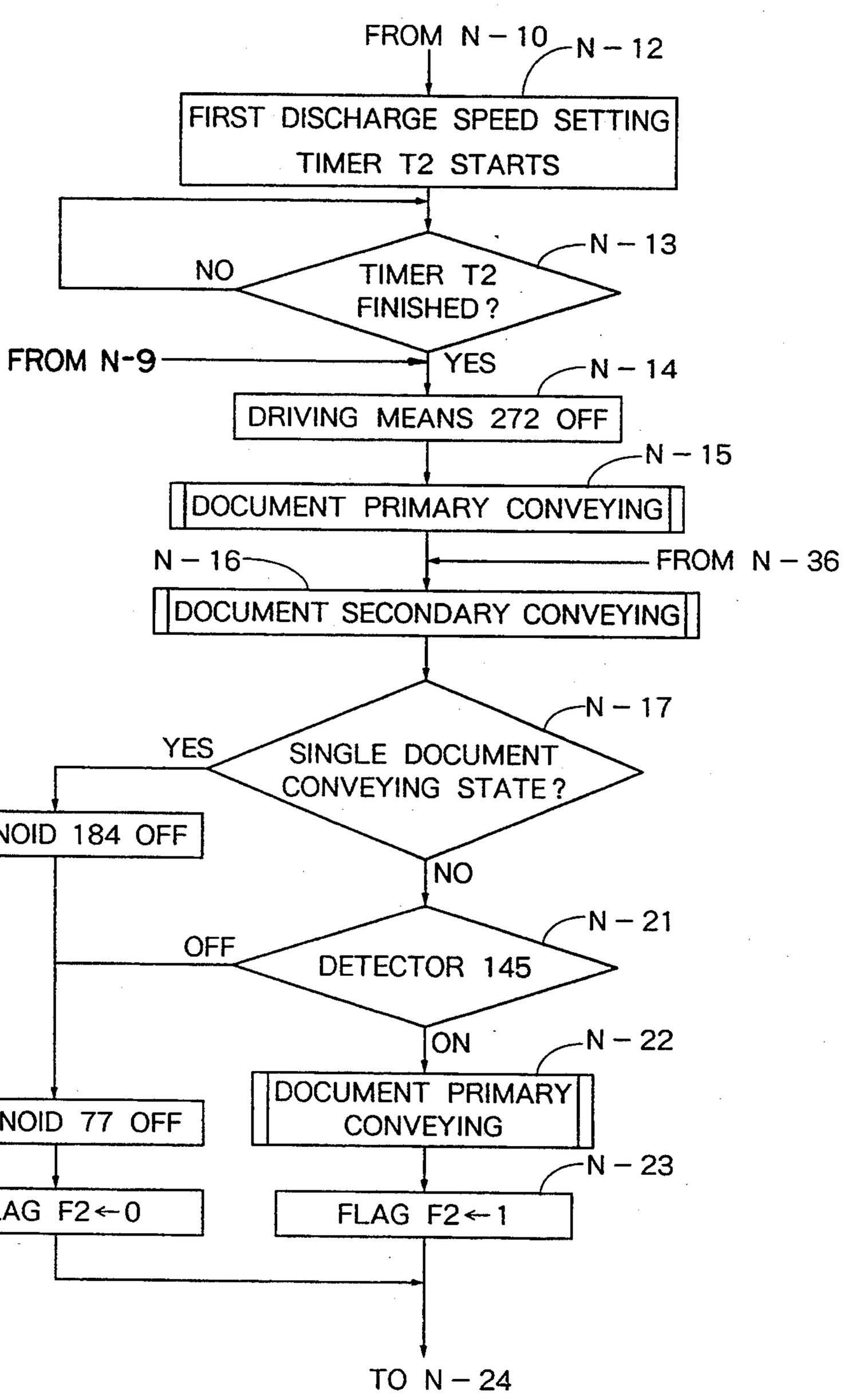

FROM N – 10
N – 12
FIRST DISCHARGE SPEED SETTING
TIMER T2 STARTS
N – 13
NO
TIMER T2
FINISHED ?
FROM N-9
YES
N – 14
DRIVING MEANS 272 OFF
N – 15
DOCUMENT PRIMARY CONVEYING
N – 16
FROM N – 36
DOCUMENT SECONDARY CONVEYING
N – 17
YES
SINGLE DOCUMENT
CONVEYING STATE ?
N – 18
SOLENOID 184 OFF
NO
N – 21
OFF
DETECTOR 145
ON
N – 22
DOCUMENT PRIMARY
CONVEYING
N – 19
SOLENOID 77 OFF
N – 20
N – 23
FLAG F2←0
FLAG F2←1
TO N – 24

Fig. 12

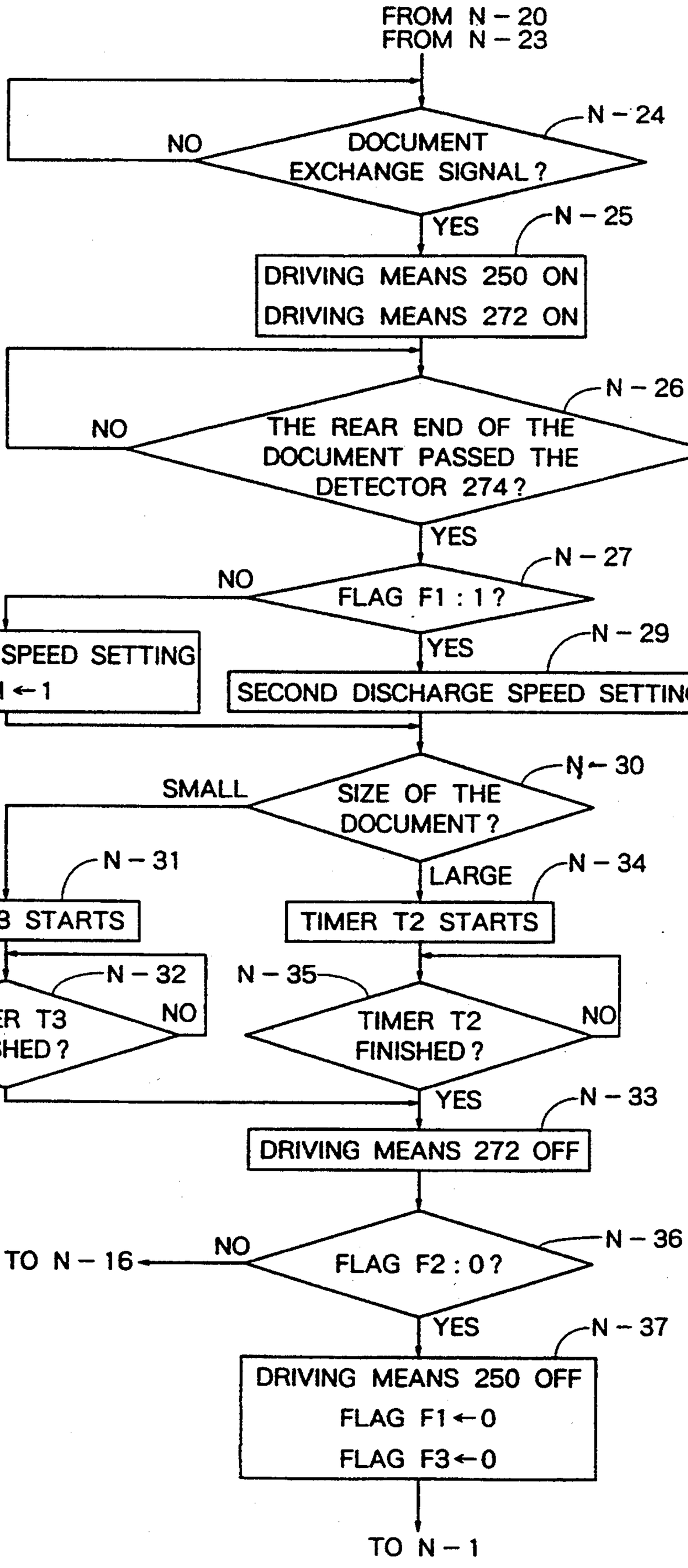

FROM N – 20
FROM N – 23
N – 24
NO
DOCUMENT EXCHANGE SIGNAL?
YES
N – 25
DRIVING MEANS 250 ON
DRIVING MEANS 272 ON
N – 26
NO
THE REAR END OF THE DOCUMENT PASSED THE DETECTOR 274?
YES
N – 27
NO
FLAG F1 : 1?
N – 28
FIRST DISCHARGE SPEED SETTING
FLAG F1 ← 1
YES
N – 29
SECOND DISCHARGE SPEED SETTING
N – 30
SMALL
SIZE OF THE DOCUMENT?
LARGE
N – 31
TIMER T3 STARTS
N – 34
TIMER T2 STARTS
N – 32
TIMER T3 FINISHED?
NO
YES
N – 35
TIMER T2 FINISHED?
NO
YES
N – 33
DRIVING MEANS 272 OFF
N – 36
NO
TO N – 16
FLAG F2 : 0?
YES
N – 37
DRIVING MEANS 250 OFF
FLAG F1 ← 0
FLAG F3 ← 0
TO N – 1

Fig. 13

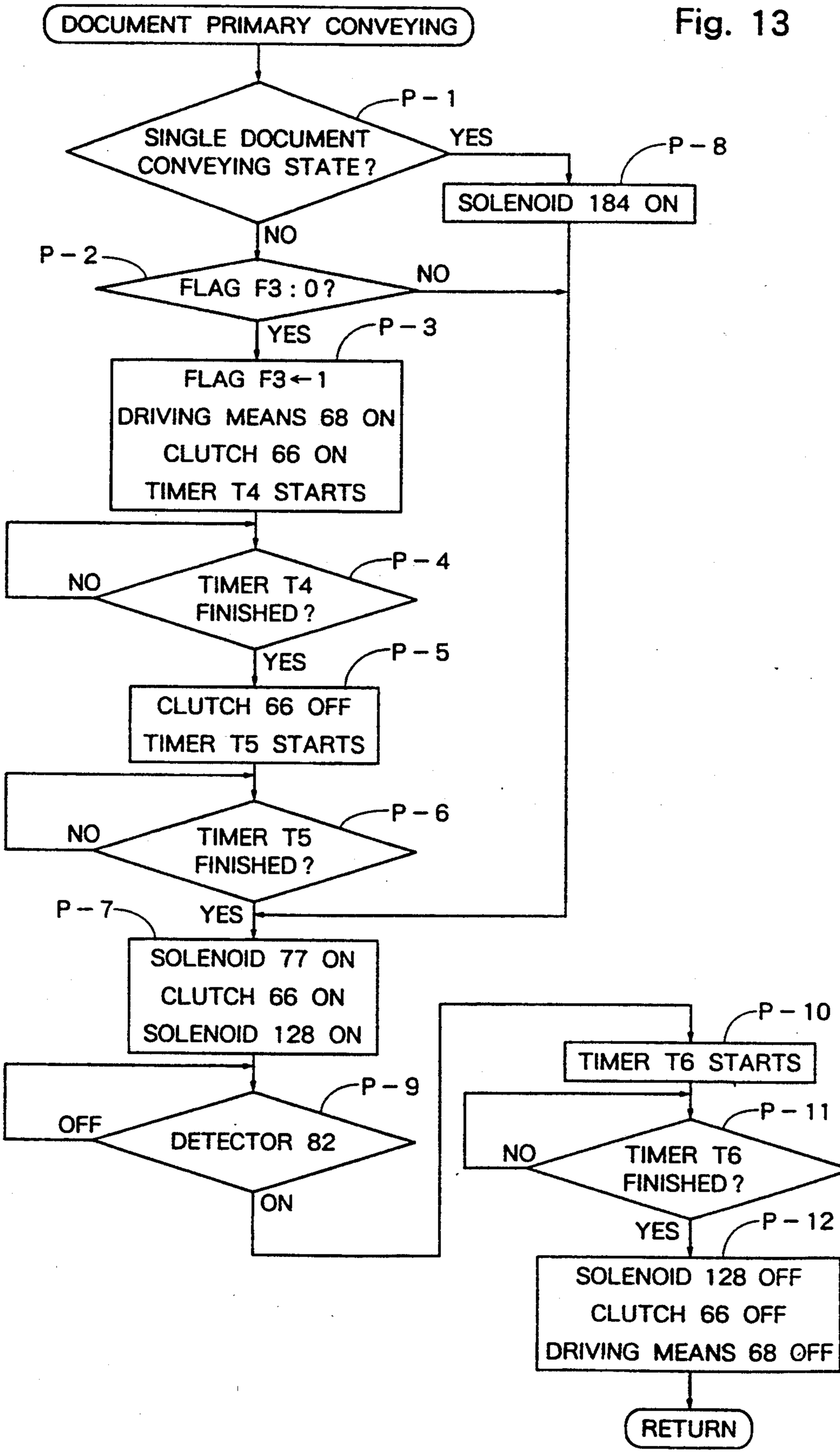
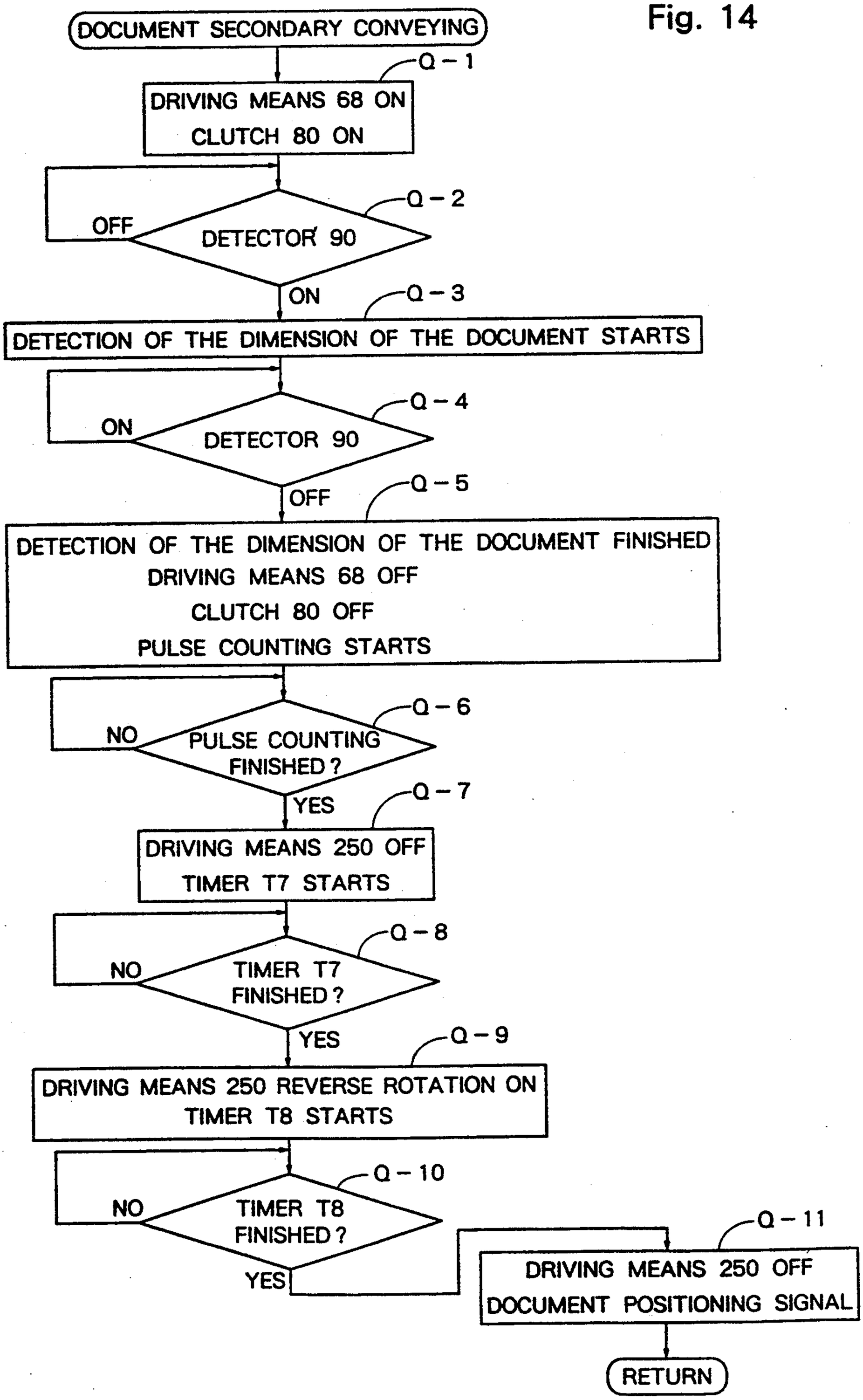

DOCUMENT PRIMARY CONVEYING
P – 1
SINGLE DOCUMENT CONVEYING STATE?
YES
P – 8
SOLENOID 184 ON
NO
P – 2
FLAG F3 : 0?
NO
YES
P – 3
FLAG F3 ← 1
DRIVING MEANS 68 ON
CLUTCH 66 ON
TIMER T4 STARTS
P – 4
NO
TIMER T4 FINISHED?
YES
P – 5
CLUTCH 66 OFF
TIMER T5 STARTS
P – 6
NO
TIMER T5 FINISHED?
P – 7
YES
SOLENOID 77 ON
CLUTCH 66 ON
SOLENOID 128 ON
P – 9
OFF
DETECTOR 82
ON
P – 10
TIMER T6 STARTS
P – 11
NO
TIMER T6 FINISHED?
YES
P – 12
SOLENOID 128 OFF
CLUTCH 66 OFF
DRIVING MEANS 68 OFF
RETURN

Fig. 14


DOCUMENT SECONDARY CONVEYING
Q-1
DRIVING MEANS 68 ON
CLUTCH 80 ON
Q-2
OFF
DETECTOR 90
ON
Q-3
DETECTION OF THE DIMENSION OF THE DOCUMENT STARTS
Q-4
ON
DETECTOR 90
OFF
Q-5
DETECTION OF THE DIMENSION OF THE DOCUMENT FINISHED
DRIVING MEANS 68 OFF
CLUTCH 80 OFF
PULSE COUNTING STARTS
Q-6
NO
PULSE COUNTING FINISHED?
YES
Q-7
DRIVING MEANS 250 OFF
TIMER T7 STARTS
Q-8
NO
TIMER T7 FINISHED?
YES
Q-9
DRIVING MEANS 250 REVERSE ROTATION ON
TIMER T8 STARTS
Q-10
NO
TIMER T8 FINISHED?
YES
Q-11
DRIVING MEANS 250 OFF
DOCUMENT POSITIONING SIGNAL
RETURN

AUTOMATIC DOCUMENT CONVEYING APPARATUS

FIELD OF THE INVENTION

This invention relates to an automatic document conveying apparatus to be applied to an image processing apparatus such as an electrostatic copying machine or an image reader.

DESCRIPTION OF THE PRIOR ART

In an automatic document conveying apparatus such as on an electrostatic copying machine or an image reader, a transparent plate which may be a glass sheet is disposed on the upper surface of a housing, and a document to be copied or a document to be read is required to be positioned onto a predetermined site of the transparent plate. For automation of a document processing operation, automatic document conveying apparatuses of various forms have been proposed and put into practice in recent years to carry a document to be copied or a document to be read onto a predetermined site of the transparent plate and to deliver the document off of the transparent plate. The prior art disclosing typical examples of the automatic document conveying apparatuses includes, for example, Japanese Laid-Open Patent Publications Nos. 229,744/1986 and 295,334/1988.

In a typical example of the automatic document conveying apparatus, a frame is so mounted on the housing of the image processing machine that the frame can be pivoted between a closed position and an open position on, as a center, a frame pivoting axial line extending along one edge of the transparent plate. The frame is nearly box-shaped usually, with its under surface being open. When it is in the closed position, the frame covers the transparent plate and when it is in the open position, it exposes the transparent plate. For placing a document on the transparent plate manually, the frame must be also opened or closed with hand. A document placing means and a document receiving means are disposed on the frame. Furthermore, within the frame, there are defined a document carrying passage extending from the document placing means to the transparent plate and a document delivery passage extending from the transparent plate to the document receiving means. When the frame is positioned at the closed position, its under surface defines a document transfer passage which extends along the transparent plate, and a document conveying passage is formed which follows the document delivery passage from the document carrying passage via the document transfer passage. Furthermore, within the frame, a document conveying means is disposed for conveying a document through the document carrying passage, the document transfer passage and the document delivery passage. This document conveying means includes a document carrying means for conveying a document through a document carrying passage, the document transfer means for conveying a document through the document transfer passage, and a document delivery means for conveying a document through the document delivery passage.

The document carrying means includes a document sending means for sending a document placed on the document placing means to the document carrying passage and a document overlappingly sending preventing means disposed on the downstream side of the document sending means for preventing two or more documents simultaneously from being conveyed through the

document carrying passage. The document sending means is composed of a carrying roller formed from a material such as a relatively soft synthetic rubber and a pressing member formed of a material such as a relatively rigid metal plate or a synthetic resin. The carrying roller is driven to rotate in the document carrying direction. The pressing member, disposed in opposition to the carrying roller, is biased toward the peripheral surface of the carrying roller by a suitable means such as an electromagnetic solenoid. The document placed on the document placing means is held between the carrying roller and the pressing member. The document overlappingly sending preventing means includes a feed roller and a separation roller disposed in opposition to each other. The feed roller is driven to rotate in the document conveying direction. On the other hand, the separation roller is connected to a rotation driving source via a torque limiter limiting a transmission torque in a direction opposite to the document conveying direction to a predetermined value, and is rotatably driven in a direction opposite to the document conveying direction within a predetermined transmission torque. The document overlappingly sending preventing means further has a restriction member which approaches or contacts the feed roller on the upper stream side of the separation roller. By the restriction action of the restriction member, documents to be sent between the feed roller and the separation roller are limited to less than a few, and only one document is allowed to advance due to the co-operative action of the feed roller and the separation roller.

A plurality of document detectors are provided in the document carrying passage, and a document detector is provided also in the document delivery passage. The document detectors disposed in the document carrying passage detect the advance of the documents sent through the document carrying passage and also detect the size of the carried documents. With a view to stacking the documents discharged to the document receiving means sequentially and properly, the document conveying speed of the document delivery means is decreased to a discharge speed smaller than a usual document conveying speed when the document detector in the document delivery passage detects the rear edge of the document.

The conventional automatic document conveying apparatus has, however, the following problems to be solved.

Firstly, it is not rare that a document such as an original of a design written on tracing paper is conveyed by the automatic document conveying apparatus. Such a document as an original of a design has higher importance in processing than ordinary copied products, and it is required to reliably prevent it from suffering breakage or injury. However, because of the special nature and/or the relatively larger size of the material of such document and further because a document is curved in many cases, it is difficult to separate the documents reliably by the document overlappingly sending preventing means, and it is relatively frequently found that the documents are clogged in the document conveying passage. Therefore, in the conventional automatic document conveying apparatus, particularly when copying is performed of an original of a design the importance of which requires reliably preventing it from suffering breakage or injury, there often is imperfect separation in the document overlappingly sending preventing means

and/or clogging in the document conveying passage. This will often result in breakage or injury of the document.

Secondly, the action of the carrying roller for sending the document placed on the document placing means to the document carrying passage depends greatly upon the pressing force of the document to be carried toward the peripheral surface of the carrying roller which is formed of a material such as a relatively soft synthetic rubber. In the conventional automatic document conveying apparatus, the pressing force drastically varies with the number of documents placed on the document placing means and whether their front portions are held between the carrying roller and the pressing member which is disposed in opposition thereto, and therefore the document carrying action by the carrying roller is unstable.

Thirdly, in the conventional automatic document conveying apparatus, when the front portion of the document is curved upwardly, the document in the document overlappingly sending preventing means contacts only the separation roller and tends to be clogged without contacting the peripheral surface of the feed roller. Furthermore, when the document has relatively low stiffness and is large in size, the document is often curved, for example with a wavy form, in the width direction on both side portions of the document sending roller, or creased in the conventional document conveying apparatus.

Fourthly, when the document is relatively large in size, the resistance to the discharge of the document is relatively large in the state where the front half portion of the document is discharged onto the document receiving means, in comparison with a document having relatively small size. Due to this fact, in the conventional automatic document conveying apparatus, when the document is relatively large, the document is not completely discharged onto the document receiving means, and the rear end of the document remains contacting the document discharge roller, thereby tending to cause incomplete discharge.

Fifthly, when no document exists on the document receiving means, namely, as the first document is being discharged onto the document receiving means, the discharged document is moved onto the surface of the document receiving means itself and therefore, experiences a relatively large resistance to moving. On the other hand, when a previously discharged document is on the document receiving means, newly discharged document is moved onto the surface of the first document and therefore, experiences a relatively small resistance to moving. In view of this fact, in the conventional automatic document conveying apparatus, the first document and the second or subsequent document considerably differ in discharge condition, and the discharged documents cannot be stacked very well.

SUMMARY OF THE INVENTION

The first object of the present invention is to provide an improved automatic document conveying apparatus wherein when the document is, for example, an original of a design for which there is high importance in preventing the document from suffering breakage or injury, such document is conveyed in a manner different from that of the ordinary documents, so that the important document can fully reliably avoid breakage or injury.

The second object of the present invention is to make the pressing force of any document to be carried to the peripheral surface of the carrying roller nearly the same regardless of the number of documents placed on the document placing means, thereby fully stabilizing the document carrying action of the carrying roller.

The third object of the present invention is to provide an improved automatic document conveying apparatus which can convey documents fully well without causing clogging even when the front portion of the documents is curved upwardly or the document has relatively low stiffness and is large in size, and without curving the document in a wavy form in a widthwise direction or forming creases in the document.

The fourth object of the present invention is to provide an improvement such that even when the document is relatively small or relatively large, the document can be discharged satisfactorily onto the document receiving means.

The fifth object of the present invention is to provide an improved automatic document conveying apparatus wherein the first document and the second or subsequent document can be discharged nearly in the same way onto the document receiving means and therefore, can be stacked very well.

In a first aspect of the present invention, the first object is achieved by disposing a state changing means which can selectively determine a continuous document conveying state and a single document conveying state. When it is important to avoid breakage or injury of a document, the single document conveying state is preselected. In this single document conveying state, (1) the separation roller in the document overlappingly sending preventing means is freely rotated in the document conveying direction; (2) the restricting means in the document overlappingly sending preventing means is placed in a non-acting position to be separated from the feed roller; or (3) the speed of conveying the document at least through the document carrying passage and the document delivery passage is lowered from a usual conveying speed.

According to the first aspect of the present invention, there is provided an automatic document conveying apparatus comprising a document placing means, a document carrying passage extending from the document placing means, a document sending means for sending a document placed on the document placing means to the document carrying passage, and a document overlappingly sending preventing means disposed downstream of the document sending means for preventing two or more documents from being conveyed simultaneously through the document carrying passage, the document overlappingly sending preventing means, including a feed roller and a separation roller, disposed in opposition to each other, between which a document is sent by the action of the document sending means, the feed roller being driven to rotate in the document conveying direction, and the separation roller being driven to rotate in a direction opposite to the document conveying direction; wherein the separation roller is detachably connected to a rotation driving source, a state changing means is disposed in relation to the separation roller, and the state changing means selectively determines a continuous document conveying state in which the separation roller is connected to the rotation driving source and driven to rotate in a direction opposite to the document conveying direction and a single document conveying state in which the separation roller it is liber-

ated from the rotation driving source and is allowed to be freely rotated in the document conveying direction.

Furthermore, according to the first aspect of the present invention, there is provided an automatic document conveying apparatus comprising a document placing means, a document carrying passage extending from the document placing means, a document sending means for sending a document placed on the document placing means to the document carrying passage, a document overlappingly sending preventing means disposed downstream of the document sending means for preventing two or more documents from being conveyed simultaneously through the document carrying passage, the document overlappingly sending preventing means including a feed roller driven to rotate in the document conveying direction and a restriction member disposed in relation to the feed roller; wherein the restriction member is mounted movably between an acting position at which it approaches or contacts the feed roller and a non-acting position at which it is isolated from the feed roller, a state changing means is disposed in relation to the restriction member, and the state changing means selectively determines a continuous document conveying state in which the restriction member is positioned at the acting position and a single document conveying state in which the restriction member is positioned at the non-acting position.

Furthermore, according to the first aspect of the invention, there is also provided an automatic document conveying apparatus comprising a document placing means, a document receiving means, a document conveying passage including a document carrying passage extending from the document placing means, a document transfer passage following a document carrying passage and extending along the transparent plate of an image processing machine, and a document delivery passage extending from the document transfer passage to the document receiving means, a document conveying means including a document carrying means for conveying a document through the document carrying passage, a document transfer means for transferring a document through the document transfer passage, and a document delivering means for discharging a document through a document discharging passage, and an operation control means; wherein a state changing means is disposed which selectively determines a continuous document conveying state and a single document conveying state, when the continuous document conveying state is determined, the control means conveys a document through at least the document carrying passage and the document transfer passage at a usual conveying speed of **V1**, and when the state changing means determines the single document conveying state, the control means allows a document to be conveyed at a conveying speed **V2**, smaller than the usual conveying speed **V1**, through at least the document carrying passage and the document transfer passage.

In a second aspect of the present invention, to achieve the second object, collar members, which are of a relatively rigid material, are mounted concentrically and rotatably on both sides of the carrying roller, which is formed of a relatively soft material, the outer diameter of the collar members are made substantially the same as or a little bit smaller than the outer diameter of the carrying roller, and both end portions of the pressing member are positioned in opposition to the collar members.

That is, according to the second aspect of the present invention, there is provided an automatic document conveying apparatus comprising a document placing means, a document carrying passage extending from the document placing means, a document sending means for sending a document placed on the document placing means to the document carrying passage, the document sending means including a carrying roller formed of a relatively soft material and driven to rotate in the document carrying direction, a pressing member formed of a relatively rigid material and disposed in opposition to the carrying roller, and a biasing means for biasing the pressing member toward the peripheral surface of the carrying roller, and the front end portion of the document placed on the document placing means being interposed between the carrying roller and the pressing member; wherein collar members formed of a relatively rigid material are concentrically and rotatably mounted on both sides of the carrying roller, the outer diameter of the collar members is substantially the same as, or somewhat smaller than, the outer diameter of the carrying roller, and both end portions of the pressing member are positioned in opposition to the collar members.

In a third aspect of the present invention, to achieve the third object, a synthetic resin film guide member is disposed on both sides of the carrying roller and the pressing member which constitute the document sending means and on both sides of the feed roller and the separation roller which constitute the document overlappingly sending preventing means which guide member extends from an upstream side of the carrying roller toward the feed roller and the separation roller and from above the carrying roller to below the nip position between the feed roller and the separation roller.

According to a third aspect of the present invention, there is provided an automatic document conveying apparatus comprising a document placing means, a document carrying passage extending from the document placing means, a document sending means for sending a document placed on the document placing means to the document carrying passage, a document overlappingly sending preventing means disposed downstream of the document sending means for preventing two or more document from being conveyed simultaneously through the document carrying passage, the document sending means including a carrying roller formed of a relatively soft material and driven to rotate in the document carrying direction, a pressing member formed of a relatively rigid material and disposed opposite to the carrying roller, and a biasing means biasing toward the peripheral surface of the carrying roller, the front portion of the document placed on the document placing means being interposed between the carrying roller and the pressing member, the document overlappingly sending preventing means including a lower side feed roller and an upper side separation roller, being disposed opposite to each other, between which a document is sent by the action of the document sending means, the feed roller being driven to rotate in the document conveying direction, and the separation roller being driven to rotate in a direction opposite to the document conveying direction; wherein on both sides of the carrying roller, the pressing member, the feed roller and the separation roller, a guide member of a synthetic resin film is disposed which extends from an upstream side of the carrying roller toward the feed roller and the separation roller and from above the carrying roller to below the nip site of the feed roller and the separation roller.

In a fourth aspect of the present invention, to achieve the fourth object, when a document to be delivered is larger than a predetermined size, the document delivering speed is decreased to the discharge speed and the operation time of the document delivering means is somewhat made longer.

According to the fourth aspect of the present invention, there is provided an automatic document conveying apparatus comprising a document placing means, a document receiving means, a document conveying passage include a document carrying passage extending from the document placing means, a document transfer passage following the document carrying passage and extending along a transparent plate of an image processing machine, and a document delivering passage extending from the document transfer passage to the document receiving means, a document conveying means including a document carrying means for conveying a document through the document carrying passage, a document transfer means for transferring a document through the document transfer passage, and a document delivering means for discharging a document through a document delivery passage, a carried document detecting means for detecting a document carried through the document carrying passage, a delivered document detecting means for detecting a document delivered through a document delivery passage, an operation control means, and when the delivered document detecting means detects the rear end of the document, the control means decreases the document delivering speed by the document delivering means to a discharge speed V3 smaller than a usual conveying speed V1 and after the lapse of a predetermined period time T, the control means stops the operation of the document delivering means; wherein when the document to be detected by the carried document detecting means is larger than a predetermined size, the predetermined time is T-L, when the document to be detected by the carried document detecting means is smaller than the predetermined size, the predetermined time is T-S, and the predetermined time T-L is longer than the predetermined time T-S.

To achieve the fifth object, in a fifth aspect of the present invention, the discharge speed of the first document to be delivered is made somewhat larger than the discharge speed of the subsequent document.

According to the fifth aspect of the present invention, there is provided an automatic document conveying apparatus comprising a document placing means, a document receiving means, a document conveying passage including a document carrying passage extending from the document placing means, a document transfer passage following the document carrying passage and extending along a transparent plate of an image processing machine, and a document delivery passage extending from the document transfer passage to the document receiving means, a document conveying means including a document carrying means for conveying a document through the document carrying passage, a document transfer means for transferring a document through the document transfer passage, and a document delivering means for discharging a document through the document discharge passage, a carried document detecting means for detecting a document carried through the document carrying passage, a delivered document detecting means for delivering a document through the document delivery passage, and an operation control means, and when the delivered document detecting means detects the rear end of the document by the control means, the document delivering speed by the document delivering means decreases to a discharge speed V3 smaller than an ordinary conveying speed V1 and after the lapse of a predetermined period of time T, the control means stops the operation of the document delivering means; wherein when from the beginning of the operation, the document to be detected by the delivered document detecting means is the first document, the discharge speed is V3-1, and when from the beginning of the operation, the document to be detected by the delivered document detecting means is the second or subsequent document, the discharge speed is V3-2, and the discharge speed V3-1 is larger than the discharge speed V3-2.

In the automatic document conveying apparatus constructed in accordance with the first aspect of the present invention, when a single document conveying state is predetermined, the separation roller or the restriction member in the document overlappingly sending preventing means is unable to operate, and its separating action is avoided, or the document conveying speed is decreased, whereby the possibility of breaking or damaging an original of a design which is highly important can be avoided reliably.

In the automatic document conveying apparatus constructed in accordance with the second aspect of the present invention, a pressing force exerted on the document by the pressing member is basically received by the collar member, and the pressing force between the carrying roller and the document contacting its peripheral surface is specified only by a predetermined partial pressure ascribable to the elastic deformation of the carrying roller. Accordingly, the pressing force is maintained nearly the same irrespective of the number of the documents, and thus, the document carrying action by the carrying roller is sufficiently stabilized.

In the automatic document conveying apparatus constructed in accordance with the third aspect of the present invention, the forward end portion of the document is introduced on the side of the feed roller further from the nip portion of the feed roller and the separation roller by the guiding action of a guide member formed of a synthetic resin film and is contacted surely on the peripheral surface of the feed roller. Furthermore, the presence of the guide member sufficiently inhibits the deformation or crease formation of the document on both side portion of the carrying roller and the pressing member, and thus, even when the front portion of the document is curved upwardly or when the document has a relatively low stiffness and is large in size, the document can be conveyed very well.

In the automatic document conveying apparatus constructed in accordance with the fourth aspect of the present invention, when the document is relatively large in size and receives a relatively large discharge resistance, the discharge operation of the document delivering means is relatively lengthened, and thus the document can be discharged relatively well on the document receiving means, whether the document is relatively small or relatively large.

In the automatic document conveying apparatus constructed in accordance with the fifth aspect of the present invention, the first document, which experiences a relatively larger moving resistance than the second or subsequent documents, is discharged at a higher discharge speed than the second or subsequent documents. Accordingly, the first document is discharged to the

document receiving means in nearly the same way as the second or subsequent documents and the discharged documents are fully well stacked.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing a preferred example of an automatic document conveying apparatus constructed in accordance with this invention provided in an electrostatic copying machine.

FIG. **2** is a sectional view showing the automatic conveying apparatus of FIG. **1**.

FIG. **3** is a partial sectional view showing a document carrying passage portion of the automatic document conveying apparatus of FIG. **1**.

FIG. **4** is a partial perspective view showing, in a cutaway manner, the document carrying passage portion of the automatic document conveying apparatus of FIG. **1**.

FIG. **5** is a top plan view showing a carrying roller and a pressing member and their related constituent elements in the automatic document conveying apparatus of FIG. **1**.

FIG. **6** is a partial perspective view showing a carrying roller and a pressing member and their related constituent elements in the automatic document conveying apparatus of FIG. **1**.

FIG. **7** is a top plan view showing a power transmission shaft and a transmission gear and their related constituent elements in the automatic document conveying apparatus of FIG. **1**.

FIG. **8** is a partial perspective view showing the correlation between a power transmission shaft and a transmission gear in the automatic document conveying apparatus of FIG. **1**.

FIG. **9** is a simplified block diagram showing elements related to a control system in the automatic document conveying apparatus of FIG. **1**.

FIG. **10** is a part of a main routine of a flow chart for illustrating the operating sequence of the automatic document conveying apparatus of FIG. **1**.

FIG. **11** is a further part of a main routine of a flow chart for illustrating the operating sequence of the automatic document conveying apparatus of FIG. **1**.

FIG. **12** is a further part of a main routine of a flow chart for illustrating the operating sequence of the automatic document conveying apparatus of FIG. **1**.

FIG. **13** is a document primary conveying sub-routine of a flow chart for illustrating the operating sequence of the automatic document conveying apparatus of FIG. **1**.

FIG. **14** is a document secondary conveying sub-routine of a flow chart for illustrating the operating sequence of the automatic document conveying apparatus of FIG. **1**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Hereinafter, the invention will be described in detail with reference to the accompanying drawings showing preferred embodiments of the automatic document conveying apparatus constructed in accordance with the present invention.

With reference to FIGS. **1** and **2**, in the illustrated embodiments, an automatic document conveying apparatus shown generally by **2** is applied to an electrostatic copying machine **4**. The electrostatic copying machine **4** has a nearly parallelepiped housing **6**, and on the upper surface of the housing **6**, a transparent plate **8** (FIG. **2**), which may be made of glass, is provided. A document to be copied is required to be positioned on a required site of the transparent plate **8**. The electrostatic copying machine **4** may be of a known form, and therefore, the construction of the electrostatic copying machine **4** will be omitted.

The automatic document conveying apparatus **2** constructed in accordance with the present invention includes a main frame **10**. The main frame **10** is mounted on the housing **6** of the electrostatic copying machine **4** in such a manner that it is free to pivot between a closed position, shown by a solid line in FIG. **1**, and an open position shown, by a two-dotted chain line in FIG. **1**, on, as a center, a main frame pivoting axial line extending along the rear edge of the transparent plate **8**. The main frame **10** includes a frame member **12** which is nearly box-shaped. The under surface of the frame member **12**, which may be molded from a suitable synthetic resin, is open as can be understood from FIG. **2**. One end portion (the left end portion in FIG. **2**) of the main frame **10** is bulged upwardly (in this end portion, a document carrying passage is formed as described later). Similarly, the other end portion (the right end portion in FIG. **2**) of the main frame **10** is bulged upwardly (in this other end portion, a document discharge passage is formed as described later). As is clearly shown in FIG. **1**, in the first upper end portion of the main frame **10**, an upstanding front wall portion **14** and an upstanding rear wall portion **16** are formed, spaced from each other in a widthwise direction (in a direction perpendicular to the sheet surface in FIG. **2**) on the frame member **12**. Between the front wall portion **14** and the rear wall portion **16**, a document placing means **18**, extending in the right direction in FIG. **2**, is disposed. This document placing means **18** includes a placing member **20** and an auxiliary placing member **22**. The placing member **20** is nearly rectangular, and extends in the right direction in FIG. **2** from a forward end portion mounted between the front wall portion **14** and the rear wall portion **16**. A pair of width regulating members **24**, which are freely movable in a direction approaching each other or in an isolated direction from each other, are disposed on the upper surface of the placing member **20**. A concave portion **26** is formed at the center in a widthwise direction of the placing member **20**, and the width of the latter half portion of this concave portion **26** nearly corresponds to the width of the auxiliary placing member **22**. The auxiliary placing member **22** is mounted pivotably between an acting position, shown by a solid line, and a non-acting position, shown by a two-dotted chain line, at the center in a widthwise direction of the rear end of the placing member **20**. When a document to be copied, i.e., a document placed on the document placing means **18** is relatively large, the auxiliary placing member **22** is positioned at the acting position extending further rearwardly from the rear end of the placing member **20**, and the rear end portion of the document is supported on the auxiliary placing member **22**. When a document to be copied, i.e., a document placed on the document placing member **18** is relatively small, the auxiliary placing means **22** is positioned at the non-acting position at which the auxiliary placing means **22** is accommodated in the concave portion **26** of the placing member **20**. The upper surface of the central main portion of the frame member **12**, which is positioned below the document placing means **18**, constitutes a document receiving means **30** for receiving a document discharged from the bulged other end por-

tion of the main frame **10**. The upper surface of the central main portion of the frame member **12** constituting the document receiving means **30** is raised centrally in the longitudinal direction, namely inclinedly extends upwardly from the left portion toward the central portion in FIG. **2**, and then inclinedly extends downwardly from the central portion toward the right portion in FIG. **2**. A grip concave portion **34** is formed in the front surface of the central main portion of the frame member **12**. When main frame **10** is opened or closed pivotably between the closed position shown by a solid line in FIG. **1** and the open position shown by a two-dotted chain line shown in FIG. **1**, one hand may be put on the grip concave portion **34**.

With reference to FIGS. **1** and **2** together with FIG. **3**, an opening and closing frame **36** is disposed between the upstanding front wall portion **14** and the upstanding rear wall portion **16** of the frame member **12**. The opening and closing frame **36** is mounted pivotably on an opening and closing pivoting axial line, as a center, extending perpendicularly to the sheet surface in FIGS. **2** and **3** between a closed position shown by a solid line in FIGS. **1**, **2** and **3** and an open position shown by a two-dotted chain line in FIG. **3** (the mounting of the opening and closing frame **36** will be described in detail later).

It can be understood by reference to FIG. **4** that the upstanding front wall portion **14** of the frame member **12** has an upstanding front side plate **38** and a front cover **40** covering the front surface of the upstanding front side plate **38**, and similarly, the upstanding rear wall portion **16** of the frame member **12** has an upstanding rear side plate **42** and a rear cover **44** covering the upstanding rear side plate **42**. Referring to FIG. **3**, guide plates **46** and **48** are mounted between the upstanding front side plate **38** and the upstanding rear side plate **42**. Between the upstanding front side plate **38** and the upstanding rear side plate **42**, a guide plate **51**, to which a cover member **50** is annexed, is mounted. The main portion of the guide plate **51** extends vertically face to face to a lower half portion of the guide plate **48**. With reference to FIGS. **3** and **5**, a supporting plate **52**, extending in the width direction between the upstanding front side plate **38** and the upstanding rear side plate **42**, is disposed beneath the guide plate **46**. The supporting plate **52** has a pair of upstanding supporting walls **54** and **56** formed spaced apart in the width direction. A shaft member **58** is rotatably mounted between the pair of the upstanding supporting walls **54** and **56**, and a carrying roller **60** is fixed to the shaft member **58**. Conveniently, the carrying roller **60** is formed of a relatively soft material such as synthetic rubber. Desirably, on both sides of the carrying roller **60**, collar members **62** are rotatably mounted on the shaft member **58**. The collar members **62** may be formed from a relatively rigid material such as a suitable synthetic resin, for example, a polyacetal resin. Preferably, the outer diameter **D2** of the collar members **62** is substantially the same as, or somewhat smaller than, the outer diameter **D1** of the carrying roller **60** positioned between them ($D1 \geqq D2 \geqq D1-0.1$ mm). Such collar members **62** and especially their functional effect will be described later. A pulley **64** is further fixed to the shaft member **58**, and a timing belt (not shown) is wound on the pulley **64**. This timing belt may be driven and linked to a carrying portion driving means **68** (FIGS. **2** and **9**), which may be an electric motor, through a transmission means containing a carry clutch **66** (FIG. **9**), which may be an electromagnetic clutch, and the carrying roller **60** is selectively driven to rotate counterclockwise in FIGS. **2** and **3**. The carrying roller **60** and the collar members **62** disposed on both sides thereof are projected upwardly through an opening formed in the guide plate **46**. Although not shown in FIG. **5**, a shaft member **70** (FIG. **3**) is rotatably mounted on the pair of the upstanding supporting walls **54** and **56**. A feed roller **72** (FIG. **3**) formed from a suitable material such as synthetic rubber is fixed to the shaft member **70**. The shaft member **70** is drivingly connected to the carrying portion driving means **68** (FIGS. **2** and **9**) via the carrying clutch **66** (FIG. **9**), and the feed roller **72** is selectively driven to rotate counterclockwise in FIGS. **2** and **3**. The feed roller **72** is also projected upwardly through an opening formed in the guide plate **46**. With reference to FIGS. **3** and **5**, a shaft member **74**, is also rotatably mounted between the pair of upstanding supporting walls **54** and **56**, and a pair of stopper members **76** are fixed to the shaft member **74**. The stopper members **76** are located outside of the carrying roller **60** and the collar members **62** in a widthwise direction. An electromagnetic solenoid **77** (FIG. **9**) is connected to the shaft member **74**, and by the action of the electromagnetic solenoid **77**, the stopper members **76** are selectively positioned between an acting position shown by a solid line in FIG. **3** and a non-acting position shown by a two-dotted chain line in FIG. **3**. When the stopper members **76** are positioned at the acting position, the forward end portions of the stopper members **76** are projected upwardly through the opening formed in the guide plate **46** between the carrying roller **60** and the feed roller **72**. When the stopper members **76** are positioned at the non-acting position, the forward end portions of the stopper members **76** are withdrawn downwardly of the guide plate **46**.

With reference to FIG. **3**, a delivery roller **78** is rotatably mounted between the upstanding front side plate **38** and the upstanding rear side plate **42** in relation to the guide plate **48**. The delivery roller **78** is projected toward the left direction in FIG. **3** through an opening formed in the guide plate **48**. The delivery roller **78** is drivingly connected to the carrying portion driving means **68** via a delivery clutch **80** (FIG. **9**), and in FIGS. **2** and **3**, is selectively driven to rotate counterclockwise. Between the upstanding front side plate **38** and the upstanding rear side plate **42** in relation to the guide plate **48**, document detectors **82**, **84** and **86** (see also FIG. **9**) are disposed widthwise at intervals in a somewhat upstream position of the delivery roller **78**. These document detectors **82**, **84** and **86** are constructed of reflection-type optical detectors including an emitting element and a receiving element, and via an opening formed in the guide plate **48**, they detect a document delivered along the guide plate **48**. Furthermore, a pressing roller **88** and a document detector **90** are disposed in relation to the guide plate **51**. The pressing roller **88** is mounted via a mounting member **92** formed of a spring steel, and by the resilient biasing action of the mounting member **92**, it is pressed against the delivery roller **78** through an opening formed in the guide plate **51**. The document detector **90** is also made of a reflection-type optical detector including an emitting element and a receiving element, and detects a document delivered along the guide plate **51** through an opening formed in the guide plate **51**.

With reference to FIGS. **3** and **4**, the opening and closing frame member **36** disposed between the up-

standing front wall portion **14** and the upstanding rear wall portion **16** includes a main member **94** and a cover member **96**. As clearly shown in FIG. **4**, the main member **94** includes a guide plate **98** extending widthwise and a front wall plate **100** and a rear wall plate **102** fixed to both sides of the guide plate **98**. A cylindrical short shaft **104** which substantially extends horizontally is mounted in the upstanding front side plate **38** in the main frame **10**, and a cylindrical short shaft **106** which substantially extends horizontally is also mounted in the upstanding rear side plate **42** in the main frame **10**. The front wall plate **100** of the opening and closing frame member **36** is rotatably mounted on the short shaft **104**, and the rear wall plate **102** of the opening and closing frame member **36** is rotatably mounted on the short shaft **106**. Thus, the opening and closing frame member **36** is mounted on the main frame **10** and is pivotable about a pivoting axial line (that is, the central axial line of the short shafts **104** and **106**), which extends substantially horizontally, between a closed position shown by a solid line in FIG. **3** and an open position shown by a two-dotted chain line in FIG. **3**. When the opening and closing frame member **36** is positioned at the closed position, a document carrying passage **108** is defined. More specifically, the upstream portion of the document carrying passage **108** is defined between the Guide plate **46** disposed in the main frame **10** and the Guide plate **98** disposed on the opening and closing frame member **36**, and the downstream portion of the document carrying passage **108** is defined between the Guide plate **48** and the guide plate **51** disposed on the main frame **10**.

With reference to FIG. **6** together FIGS. **3** to **5**, there are provided a pair of projecting pieces **109** projected upwardly, spaced widthwise at a distance, on the upper surface of the upstream end portion (right end portion in FIG. **3**) of the guide plate **98** in the opening and closing frame member **36**. A shaft member **110** is rotatably mounted between the pair of the projecting pieces **109**. A pressing member **112**, formed preferably from a relatively rigid material, e.g., a suitable metal such as a steel sheet or a suitable synthetic resin such as polyacetal, is fixed to the shaft member **110**. The pressing member **112** is fixed at its upper end portion to the shaft member **110** by a set screw **114**. A recess **116** is formed centrally widthwise in the upstream portion of the guide plate **98**, and the main portion of the pressing member **112** extends downwardly and downstream in a required form and is projected beneath the guide plate **98** through the recess **116** of the guide plate **98**. One end portion of the shaft member **110** is projected outwardly widthwise, and an input member **120** is fixed to its projecting end portion by a set screw **118**. This input member **120** has a downwardly projecting connecting portion **122** and a contacted portion **124** projecting on the downstream side. As clearly shown in FIG. **6**, a mounting bracket **126** having an L-shaped cross section is fixed to the upper surface of the guide plate **98** adjacent to the pressing member **112**. The main body portion of an electromagnetic solenoid **128** is mounted on the mounting bracket **126**. A pin member **130** is fixed to the upstanding wall portion of the mounting bracket **126**, and a transmission member **132** is pivotably mounted on the pin member **130**. The transmission member **132** has a first arm **134** that downwardly projects and a second arm **136** that projects inwardly in the width direction. The first arm **134** is inserted into a notch formed in the output rod of the electromagnetic solenoid **128**, and by inserting a linking pin **138** that extends through the output rod of the electromagnetic solenoid **128** into a slit **140** formed in the first arm **134**, the first arm **134** of the transmission member **132** is pivotably connected to the output rod of the electromagnetic solenoid **128**. The second arm **136** of the transmission member **132** extends above the contacted portion **124** of the input member **120**. Furthermore, a tension coil spring **144** is provided between the upstanding wall portion of the mounting bracket **126** and the linking portion **122** of the input member **120**. When the electromagnetic solenoid **128** is in the deenergized state, the pressing member **112** is positioned in a non-acting position shown by a solid line in FIGS. **2** and **3** by the resilient biasing action of the spring **144**. In this non-acting position, the forward end portion of the pressing member **112** is isolated upwardly from the peripheral surface of the carrying roller **60**, and is brought into contact with the lower surface of the guide plate **98**. When the electromagnetic solenoid **128** is energized to draw back the output rod, as is shown by a two-dotted chain line in FIG. **6**, the transmission member **132** is pivoted counterclockwise as seen on an upstream side, and the second arm **136** of the transmission member **132** comes into contact with the contacted portion **124** of the input member **120** to move it downwardly. Accordingly, the shaft member **110** to which the pressing member **112** is fixed is rotated counterclockwise in FIG. **3**, and thus, the pressing member **112** is biased toward the carrying roller **60** by a biasing force defined by the magnetic shrinking force of the electromagnetic solenoid **128**.

As is clearly shown in FIG. **5**, the length of the pressing member **112** in the widthwise direction is larger than the length of the carrying roller **60** in the widthwise direction, and both end portions of the pressing member **112** are located oppositely to the collar members **62**. As described later, a plurality of documents are laid in the stacked state on the document placing means **18**, and the front end portions of such plural documents are inserted between the carrying roller **60** as well as the collar members **62** and the pressing member **112**, and pressed onto the peripheral surface of the carrying roller **60** and the collar members **62** by the pressing member **112**. The carrying roller **60** is formed of a relatively soft material such as synthetic rubber, whereas the collar members **62** are formed of a relatively rigid material such as a synthetic resin. Furthermore, since the outer diameter of the collar members **62** rotatably mounted is substantially equal to, or a little smaller than, the outer diameter of the carrying roller **60**, the pressing force exerted on a document by the pressing member **112** (such pressing force is stipulated by a magnetic shrinking force of the electromagnetic solenoid **128**) and its specified portion of the pressing force (such specified portion is specified by an elastic deformation of the carrying roller **60**) is transmitted to the carrying roller **60**, and the remainder of the pressing force is transmitted to the collar members **62**,. Even when the pressing force varies by the variation of the thickness of documents in the stacked state, the pressing force transmitted to the carrying roller **60** is maintained nearly constant, and the variation of the pressing force varied by the thickness of the documents results in a variation of the pressing force transmitted to the collar members **62**. Hence, even when the thickness of documents in the stacked state varies, the pressing force transmitted to the carrying roller **60**, namely the pressing force between the lowermost document among documents in

the stacked state and the peripheral surface of the carrying roller, is maintained nearly constant. Accordingly, as will be stated later, by rotating the carrying roller **60** counterclockwise in FIGS. **2** and **3**, the lowermost document among documents in the stacked state can be carried to the carrying passage fully stably. When the collar members **62** are not disposed on both sides of the carrying roller **60**, the pressing force to be transmitted to the peripheral surface of the carrying roller **60** varies greatly by the variation of documents in the stacked state, and the carrying action of the document by the rotation of the carrying roller **60** tends to become unstable.

As shown in FIGS. **3** and **4**, a document detector **145** composed of a microswitch is mounted on the upper surface of the upstream end portion of the guide plate **98**. The detecting arm of the document detector **145** is projected downwardly through an opening formed in the guide plate **98**, and as will be described later, detects the document placed on the document placing means **18**.

With reference to FIGS. **3**, **4** and **6**, a pivoting member **146** is also mounted on the shaft member **110** to which the pressing member **112** is fixed. As illustrated clearly in FIG. **6**, the pivoting member **146** has a pair of arms **148** extending at an interval widthwise parallel to each other and a supporting wall portion **150** connecting the arms **148**. A free end portion of each of the arms **148** is pivotably mounted on the shaft member **110**, and thus, the pivoting member **146** is pivotably mounted on the shaft member **110**. A restriction member **152** is fixed to the inner surface of the supporting wall portion **150** of the pivoting member **146** by a pair of set screws **151**. The restriction member **152** is composed of a rigid metal plate portion **154** and a synthetic rubber portion **156**. The metal plate portion **154** has a mounting portion extending downwardly along the inner surface of the supporting wall portion **150** of the pivoting member **146** and a supporting portion extending downwardly inclinedly in the downstream side following the mounting portion, and the rubber plate portion **156** is adhered to the supporting portion. It is understood by reference to FIG. **3** that the lower half portion of the restriction member **152** is projected downwardly through an opening formed in the guide plate **98**. As shown clearly in FIGS. **4** and **7**, a mounting bracket **162** having an L-shaped cross section is fixed, correspondingly to the mounting bracket **126**, to the upper surface of the guide plate **98**. The mounting bracket **126** and the mounting bracket **162** extend in alignment widthwise, and the pivoting member **146** is arranged between the mounting bracket **126** and the mounting bracket **162** with widthwise direction. A sliding member **164** is mounted on the upstanding wall portions of the mounting brackets **126** and **162** so that it can be freely moved widthwise. More specifically, as clearly shown in FIG. **4**, slits **166** and **168** extending widthwise are formed widthwise at an interval on the sliding member **164**, and guide screw members **170** and **172** are screwed to the upstanding wall portions of the mounting brackets **126** and **162** through the slits **166** and **168**. The guide screw members **170** and **172** have guide shaft portions having outer diameters corresponding to the widths of the slits **166** and **168**, and when the slits **166** and **168** are guidedly moved with respect to the guide screw members **170** and **172**, the sliding member **164** is slidably moved widthwise. A guided pin **174** projecting in a downstream direction is fixed to the outer surface of the supporting wall portion **150** of the pivoting member **146** to which the restriction member **152** is fixed. On the other hand, a guide slit **176** having a lower portion **178** and an upper portion **180** connected to each other via an inclined portion is formed in the sliding member **164**, and the guided pin **174** is inserted in the guide slit **176**. A tension coil spring **182** constituting an elastic biasing means is provided between one end of the sliding member **164** and the mounting bracket **162**. A main body portion of an electromagnetic solenoid **184** constituting a state changing means is fixed onto the guide plate **98** which is adjacent to the other end of the sliding member **164**. The output rod of the electromagnetic solenoid **184** is connected to the other end portion of the sliding member **164** via a linking pin **185**. When the electromagnetic solenoid **184** is de-energized, the elastic biasing action of the spring **182** positions the sliding member **164** at a non-changing position shown by a solid line. In this case, the guided pin **174** disposed in the pivoting member **146** is positioned in the lower portion **178** of the guide slit **176** of the sliding member **164**. At this time, the restricting member **152** is positioned at an acting position shown by a solid line in FIG. **3**, and the forward end of the restriction member **152** approaches or contacts the peripheral surface of the above-mentioned feed roller **72** (continuous document conveying state). When the electromagnetic solenoid **184** is energized, the sliding member **164** is moved to a changing position shown by a two-dotted chain line against the elastic biasing action of the spring **182**. In this case, the guided pin **174** disposed in the pivoting member **164** is positioned in the upper portion **180** from the lower portion **178** of the guide slit **174** of the sliding member **164**. This somewhat pivots the restriction member **152** clockwise in FIG. **3** to the non-acting position shown by a two-dotted chain line in FIG. **3**, and the forward end of the restriction member **152** is isolated from the peripheral surface of the feed roller **72** (single document conveying state).

With reference to FIGS. **3** and **4**, a mounting bracket **186** is further fixed to the upper surface of the guide plate **98**. A pair of projecting pieces **188** projecting upwardly are formed at an interval widthwise, and a supporting bracket **190** is pivotably mounted on the projecting pieces **188**. The supporting bracket **190** has a pair of side wall portions **192** disposed at an interval widthwise and an upper wall portion **194** extending between the side wall portions **192**, and one end portion of each of the side wall portions **192** is pivotably connected to the projecting pieces **188** of the mounting bracket **186** via a short shaft **196**. A shaft member **198** is rotatably mounted between the other end portions of the side wall portions **192**. A separation roller **202** is mounted to the shaft member **198** via a torque limiter **200** restricting the transmission torque in the counterclockwise direction in FIG. **3** (in a reverse direction to the document conveying direction) to a predetermined value. Conveniently, the separation roller **202** is formed of a suitable synthetic rubber. A projecting piece **204** projecting upwardly in an downstream side of the recess **116** is formed in an upstream end portion of the guide plate **98**. A tension coil spring **206** is provided between the projecting piece **204** and the upper wall portion **194** of the supporting bracket **190**. The separation roller **202** mounted on the supporting bracket **190** is projected downwardly through an opening **208** formed in the guide plate **98**, and by the elastic biasing action of the spring **206** it is pressed against the feed roller **72**.

With reference to FIGS. **4** and **7**, a mounting piece **210** is fixed to the upper surface of the guide plate **98** in the rear of the opening **208**. A transmission shaft **212** is mounted rotatably and movably in the axial direction between the mounting piece **210** and the rear wall plate **102** of the main member **94**. The shaft member **198** is connected to the inner end portion of the transmission shaft **212** via a joint means **214**. The joint means **214** is constructed of a known pin joint, and includes a connecting sleeve **216** mounted to the inside end portion of the transmission shaft **212**, a connecting pin **218** fixed to the inside end portion of the transmission shaft **212** and inserted through a slit of the connecting sleeve **216**, and a connecting pin **220** fixed to the end portion of the shaft member **198** and inserted through a slit of the connecting sleeve **216**. Between the mounting piece **210** and the connecting sleeve **216**, a compression coil spring **222** is fitted on the transmission shaft **212**. Such spring **222** elastically biases the connecting sleeve **216**, or the transmission shaft **212** inwardly widthwise, and resiliently maintains the connection between the transmission shaft **212** and the shaft member **198** via the joint means **214**.

A flange member **224** is also fixed to the transmission shaft **212**. An interlocking member **226** is fixed to the sliding member **164** correspondingly to the flange member **224**. The interlocking member **226** has formed therein a suspending portion having a notch which receives the transmission shaft **212**, and such suspending portion strides the transmission shaft **212** adjacent to the flange member **224**. When the electromagnetic solenoid **184** is de-energized and the sliding member **164** is positioned at a non-changing position shown by a solid line shown in FIG. **4**, the suspending portion of the interlocking member **226** is isolated, inwardly in the widthwise direction, from the flange member **224** of the transmission shaft **212**, and the transmission shaft **212** is maintained at a connecting position shown by a solid line in FIG. **3**. On the other hand, when the electromagnetic solenoid **184** is energized and the sliding member **164** is moved to a changing position shown by a two-dotted chain line shown in FIG. **4**, the suspending portion of the interlocking member **226** comes into contact with the flange member **224**, and the transmission shaft **212** is moved outwardly to some extent in the widthwise direction against the elastic biasing action of the coil spring **222** to place it at an isolated position. The outer end portion of the transmission shaft **212** goes through the rear wall plate **102** in the main portion **94** of the opening and closing frame member **36**, and is projected between the rear wall plate **102** and the upstanding rear side plate **42** of the main frame member **10**. A transmission gear **228** is movably mounted in the axial direction at the projecting end portion of the transmission shaft **212**. The transmission gear **228** is connected to the carrying portion driving means **68** (FIGS. **2** and **9**) via a suitable transmission means (not shown) containing other transmission gears and the carrying clutch **66** (FIG. **9**). As clearly illustrated in FIG. **8**, an annular concave portion **232** is formed on the outer surface of the transmission gear **228**, and a groove **234** extending diametrically is formed in the bottom surface of the annular concave portion **232**. On the other hand, a transmission pin **236** extending diametrically is mounted on the projecting end portion of the transmission shaft **212**. When the above electromagnetic solenoid **184**, constituting the state-changing means, is de-energized and the transmission shaft **212** is maintained at a connecting position, the transmission pin **236** of the transmission shaft **212** is positioned within the groove **234** of the transmission gear **228**. Accordingly, the transmission shaft **212** is drivingly connected to the transmission gear **228**, and the separation roller **202** mounted on the shaft member **198** is connected to the carrying portion driving means **68** via the torque limiter **202**, the transmission shaft **212**, the transmission gear **228**, and the carrying clutch **66** (continuous document conveying state). On the other hand, when the electromagnetic solenoid **184** is energized and the transmission shaft **212** is moved to the separation position outwardly in the widthwise direction, the transmission pin **236** of the transmission shaft **212** is isolated from the groove **234** of the transmission gear **228** and is positioned within the annular concave portion **232**. As a result, the transmission shaft **212** can be rotated freely with respect to the transmission gear **228**, and accordingly the separation roller **202** mounted on the shaft member **198** can be freely rotated in the document conveying direction (clockwise in FIG. **3**) (single document conveying state). When the electromagnetic solenoid **184** is de-energized, the transmission pin **236** of the transmission shaft **212** is again advanced in the groove **234** of the transmission gear **228** and the transmission shaft **212** is drivingly connected to the transmission gear **228**. When the electromagnetic solenoid **184** is de-energized but the transmission pin **236** of the transmission shaft **212** is not adjusted in an angular position to the groove **234** of the transmission gear **228**, the transmission pin **236** cannot be advanced in the groove **234**. However, when the transmission gear **228** begins to be rotated by the carrying portion driving means **68** (FIG. **9**), the groove **234** is immediately adjusted to the transmission pin **236**, and the transmission pin **236** is advanced in the groove **234**.

With reference to FIGS. **3** and **5**, a pair of guide members **238** are disposed in an upstream portion of the document carrying passage **108**. The guide members **238** are formed from a suitable synthetic resin film such as a polyester film. As can be understood from FIG. **5**, each of the guide members **238** is disposed between the pressing member **112** and the stopper member **76**. As illustrated clearly in FIG. **3**, the guide member **238** is adhered, at the upstream end portion thereof, to the under surface of the upstream end portion of the guide plate **98** disposed in the opening and closing frame **36**, and extends inclinedly downwardly from the upstream end portion in a downstream direction. Its downstream end portion contacts the upper surface of the guide plate **46** disposed in the main frame member **10**. The downstream end portion of the guide member **238** passes below the forward end of the restriction member **152** and extends below the nip site between the feed roller **72** and the separation roller **202**. Such a pair of the guide members **238** properly guide a document that is placed on the document placing means **18** and carried in the document carrying passage **108**, and effectively prevent clogging of the document. Furthermore, the formation of an undesirable deformation or crease in the document is effectively prevented on both surfaces of the carrying roller **60** and the pressing member **112**. When the guide members **238** are not provided, and especially if the document is curved upwardly at a front portion, the forward end portion of the document carried in the document carrying passage **108** does not contact the peripheral surface of the feed roller **72**, but contacts only the separation roller **202** and/or the restriction member **152**, so that the advance of the document is impeded and clogging of the document tends to

occur. Furthermore, when the guide members **238** are not provided, and especially if the document has a relatively weak stiffness and is large in size, the document tends to be curved in a wavy form or to be creased on both areas of the central portion of the document pressed by the peripheral surface of the carrying roller **60** due to the action of the pressing member **112**.

With reference to FIG. **2**, a conveying belt mechanism designated generally at **240** is disposed in the under portion of an open under-surface of the frame member **12** in the main frame **10**. This conveying belt mechanism **240** includes a driven belt roller **242**, a follower belt roller **244** disposed at an interval in the conveying direction, and an endless belt **246** wound on the driven belt roller **242** and the follower belt roller **244**. A plurality of pressing rollers **248** are also disposed in the conveying belt mechanism **240**. Furthermore, the driven belt roller **242** is drivingly connected, via a suitable transmission means (not shown), to a transfer portion driving means **250** which may be an transmission motor, and the transfer portion driving means **250** rotatingly drives the conveying belt mechanism **240** in a required direction. The construction of the conveying belt mechanism **240** may be of any known form, and therefore a detailed description of the construction of the conveying belt mechanism **240** itself will be omitted. As shown in FIG. **2**, when the main frame **10** is positioned in the closing position, the lower side running portion of the endless belt **246** in the conveying belt mechanism **240** is positioned along the transparent plate **8** of the electrostatic copying machine **4**, and a document transfer passage **252** is defined between the endless belt **246** and the transparent plate **8**. When the conveying belt mechanism **240** is rotatingly driven, a document is transferred through the document transfer passage **252**.

With reference to FIG. **2**, a document delivery passage **254** following the document transfer passage **252** is defined in a right end bulged portion in the main frame **10**. The delivery passage **254** is defined by guide plates **256**, **258** and **260**, and extends in a nearly inverse-C shape from an upstream end following the document transfer passage **252** to a discharge opening **262** formed in the upstream end of the document receiving means **30**. A delivery roller pair composed of a driven roller **264** and a follower roller **266**, and a discharge roller pair, composed of a driven roller **268** and a follower roller **270**, are provided in the document delivering passage **252**. The driven rollers **264** and **268** are drivingly connected to a delivering portion driving means **272**, which may be a transmission motor, via a suitable transmission means (not shown), and driven to rotate clockwise in FIG. **2**. Furthermore, a document detector **274** for detecting a document through the document delivering passage **254** is disposed in the document delivery passage **254**. This document detector **274** may be an optical detector having a light receiving element and a light emitting element.

As illustrated simply in FIG. **9**, the operation of the automatic document conveying apparatus **2** mentioned above is controlled by a control means **276** which may be a microprocessor. The control means **276** is connected to a control means **278** of the electrostatic copying machine **4** to which the automatic document conveying apparatus **2** is applied. With reference to the flow charts shown in FIGS. **10** to **14**, the operating sequence of the automatic document conveying apparatus **2** will be explained as described in the following.

In step N-**1**, it is judged whether or not the automatic document conveying apparatus **2** is set in the required state, more specifically it is judged whether or not the main frame **10** is not in the open position shown by a two-dotted chain line shown in FIG. **1** but positioned in the closed position shown by a solid line in FIGS. **1** and **2**, and it is judged whether the opening and closing frame member **36** is not at the open state shown by a two-dotted chain line in FIG. **3** but positioned at the closed position shown by a solid line in FIGS. **1**, **2** and **3**. The above judgements are made by determining whether a plurality of safety switches **279** (FIG. **9**), which may be of any known form, are closed or not. When the automatic document conveying apparatus **2** is set in a required state and the safety switch **279** is closed, the operation goes to step N-**2**, and it is judged whether the document detector **145** detects a document or not. A document to be copied is placed on the document placing means **18** by advancing its forward end portion in an upstream portion of the document carrying passage **108**, and the front end of the document comes into contact with the stopper member **76** positioned in an operating position. Hence, when the document is placed as required on the document placing means **18**, the document detector **145** detects the document. Then, the operation goes to step N-**3**, and it is judged whether a copy starting key (not shown) disposed in the electrostatic copying machine **4** is manually operated or not. And then, the operation goes to step N-**4**, and a state changing switch **280** (FIGS. **1** and **9**) disposed on the upper surface of the opening and closing frame member **36** is manually operated, and it is judged whether a single conveying state is selected or not. When usually a plurality of documents are to be copied, the operator can select a continuous document conveying state without manually operating the state changing switch **280**. On the other hand, when a document to be copied is an origin of a design drawn on a tracing paper, etc. which has a high importance of avoiding breakage or damage reliably, the operator operates the state changing switch **280** to determine a single document conveying state. When a single document conveying state is not selected and a continuous document conveying state is selected, the operation goes to step N-**5**, and the output speed of the carrying portion driving means **68**, the transfer portion driving means **250** and the delivery portion driving means **272** is set at an ordinary conveying speed **V1** (for example, a document conveying speed of about 700 mm/sec.). On the other hand, when a single document conveying state is selected, the operation goes to step N-**6**, and the output speed of the carrying portion driving means **68**, the transfer portion driving means **250** and the delivering portion means **272** is set at a low conveying speed **V2** which may be about 60 to 80% of the ordinary speed ($0.6 \times V1 < V2 < 0.8 \times V1$). Thus, the possibility of breaking and damaging a document having high importance by conveying it at a relatively high speed can be fully reliably avoided.

Then, the operation goes to step N-7, and the transfer portion driving means **250** and the delivery portion driving means **272** are energized. Furthermore, the timer **T1** included in the control means **276** begins to count timing. In step N-**8**, it is judged whether the time **T1** has counted a predetermined period of time which may be about 800 msec or not. When the timer **T1** has counted a predetermined period of time, the operation goes to step N-**9**, and it is judged whether the document detector **274** disposed on the document delivery passage

254 detects a document or not. When there is a document which has been forgotten on the transparent plate 8 of the electrostatographic copying machine 4, and the transfer portion driving means 250 and the delivery portion driving means 272 are energized in the step N-7, by the action of the conveying belt mechanism 240, the delivering roller pair 264 and 266 and the discharge roller pair 268 and 279, the forgotten document is conveyed through the document transfer passage 252 and the document delivery passage 254, and the document detector 274 detects the document. In this case, the operation goes to step N-10, and it is judged whether the document detector 274 has not detected a document, namely whether the rear end of the document has passed the document detector 274 or not. When the document detector 274 detects the document, the operation goes to step N-11. A flag F1 included in the control means 276 is set at 1. When the document detector 274 no longer detects the document, the operation goes to step N-12, and the output speed of the delivering portion driving means is set at a first discharge speed V3-1 which is conveniently 30 to 40% of an ordinary conveying speed V1 ($0.3\times V1<V3-1<0.4\times V1$), and the timer T2 included in the control means 276 begins to count timing. In step N-13, it is judged whether the timer T2 has counted a predetermined timing which may be about 500 msec (this predetermined timing is a timing suitable for discharging the rear end of the forgotten document which has passed the document detector 274 onto the document receiving means 30). When the timer T2 has counted a predetermined period of time, the operation goes to step N-14, and the delivery portion driving means 272 is deenergized. When the document detector 274 does not detect a document in step N-9, namely when there is no forgotten document on the transparent plate 8 of the electrostatographic copying machine 4, step N-9 directly goes to step N-14.

Then, the operation goes to step N-15 and a document primary conveying is carried out. The document primary conveying will be explained with reference to FIG. 13. It is judged in step P-1 whether a single document conveying state is selected or not. When a continuous document conveying state but not a single document conveying state is selected, the operation goes to step P-2, and it is judged whether the prescribed value of the flag F3 included in the control means 276 is 0 or 1. When the document carried from the document placing means 18 is a first document, the prescribed value of the flag F3 is 0. In this case, the operation goes to step P-3, and the prescribed value of the flag F3 is adjusted to 1. The carrying portion driving means 68 is energized, the carrying clutch 66 is energized, and the timer T4 included in the control means 276 beings to count the timing. Then, in step P-4, it is judged whether the timer T4 has counted a predetermined period of time, which may be about 300 msec, or not. When the carrying portion driving means 68 and the carrying clutch 66 are energized over the period of time until the timer T4 finishes counting, the carrying roller 60 is driven to rotate in the document carrying direction, the document is advanced until the forward end of the document abuts surely on the forward end of the stopper member 76. Furthermore, when a single document conveying state is returned to a continuous document conveying state, the electromagnetic solenoid 184 constituting the state changing means whose operation is to be described later, is de-energized, the transmission shaft 212 is returned to a connecting position, and connected to the transmission gear 228. But when the transmission pin 236 of the transmission shaft 212 and the groove 234 of the transmission gear 228 are not adjusted in an angular position at the time of energizing the electromagnetic solenoid 184, the transmission pin 236 is immediately adjusted to the groove 234 by the rotation of the transmission gear 228 during the time counting of the timer T4, and the transmission pin 236 is advanced in the groove 234. Then, the operation goes to step P-5, and the carrying clutch 66 is de-energized, and the timer T5 included in the control means 276 begins to count. In step P-6, it is judged whether or not the timer T5 has counted a predetermined period of time which may be about 20 msec (such period of time surely ensures that mechanical connection in the de-energized carrying clutch 66 is surely canceled). Then, in step P-7, the electromagnetic solenoid 77 annexed to the stopper member 76 is energized. Therefore, the stopper member 76 is withdrawn to a non-operating position shown by a two-dotted chain line in FIG. 3. Thus, the carrying clutch 66 is again energized, and the electromagnetic solenoid 128 annexed to the pressing member 112 is energized. Therefore, the pressing member 112 is biased toward the carrying roller 60 and pressed against the document. Accordingly, the lowermost one (or several) document (or documents) among those placed in the stacked state on the document placing means 18 is (or are) carried into the document carrying passage 108 by the action of the carrying roller 60 rotated in the document conveying direction. The restricting member 152 approaching or contacting the feed roller 72 rotated in the document conveying direction functions so as to restrict the number of documents fed to a nip position between the feed roller 72 and the separation roller 202 to two documents or less. To a predetermined rotating torque value, the separation roller 202, rotated in a reverse direction to the document conveying direction, conveys only one document further in an downstream direction. In step P-2, when the document to be carried from the document placing means 18 is the second or a subsequent document and the flag F3 is prescribed at 1, the above step P-2 directly goes to step P-7.

When in step P-1 the document to be conveyed has importance, such as an original of a design, and therefore, a single document conveying state is selected, the operation goes from step P-1 to step P-8, and the electromagnetic solenoid 184 constituting the state changing means is energized. Thus, the restriction member 152 is elevated to a non-acting position shown by a two-dotted chain line in FIG. 3 and isolated from the feed roller 72, and the transmission shaft 212 is separated from the transmission gear 228 and the separation roller 202 can be freely rotated in the document conveying direction. Thereafter, the operation goes to step P-7 and the conveying of the document placed on the document placing means 18 is begun. When the electromagnetic solenoid 184 is energized to determine a single document conveying state, the restriction action of the restricting member 152 is canceled. Furthermore, the separation action of the separation roller 202 is canceled, and the possibility of breaking or damaging the document is fully reliably avoided at the time of the restriction action and/or the separation action.

Then, the operation goes to step P-9 from step P-7, and it is judged whether or not the document detector 82 detects the document carried into the document carrying passage 108. When the document detector 82 detects the document, the operation goes to step P-10,

and the timer T6 included in the control means 276 begins to count timing. In step P-11, it is judged whether or not the timer T6 has counted a predetermined period of time which may be about 50 msec. When the timer T6 has counted the predetermined period of time, the operation goes to step P-12, the electromagnetic solenoid 128 is de-energized, and the pressing member 112 is returned to a non-acting position. Furthermore, the carrying clutch 60 and the carrying portion driving means 68 are de-energized to stop the rotation of the carrying roller 60, the feed roller 72 and the separation roller 202. Until the timer T6 has counted a predetermined period of time, the forward end the document carried into the document carrying passage 108 is caused to abut on the nip position of the delivery roller 78 and the pressing roller 88 which are at a non-acting position. Thus, the document primary conveying comes to an end, and the main routine is returned.

Then, the step N-16 proceeds, and a document secondary conveying is carried out. The document secondary conveying will be illustrated with reference FIG. 14. In step Q-1, when the carrying portion driving means 68 is energized and also the conveying clutch 80 is energized, the conveying roller 78 is driven to rotate in the document conveying direction, and the primarily conveyed document is further conveyed. Then, the operation goes to step Q-2, and it is judged whether or not the document detector 90 disposed on the downstream end portion of the document carrying passage 108 detects the document. When the document detector 90 detects the document, the operation goes to step Q-3, and the size of the document carried onto the transparent plate 8 begins to be detected. In step Q-4, it is judged whether or not the document detector 90 has not detected the document, that is to say, whether or not the rear end of the document has passed the document detector 90. Then, the operation goes to step Q-5, the detection of the size of the document has been terminated, the carrying portion driving means 68 is de-energized, the delivering clutch 80 is de-energized, and the number of pulses formed in correspondence to the amount of driving of the transfer portion driving means 250 begins to be counted (the transfer portion driving means 250 is energized in the step N-7 and maintained in this condition). Accordingly, in the detection of the size begun in the step Q-3, the width of the document is detected according to whether or not the document detectors 84 and 86, displaced by a predetermined amount length from the center in the width direction in the document carrying passage 108, detect the document. Furthermore, the driving amount of the carrying portion driving means 68 from the detection of the forward end of the document by the document detector 90 to the passing of the rear end of the document over the document detector 90 is detected by counting the number of pulses formed correspondingly to such driving amount, whereby the length of the document in the conveying direction is detected. Then, in step Q-6, it is judged whether or not the counting of time initiated in step Q-5 is performed to a prescribed time. When counting of the predetermined period of time is terminated (at such a time, the rear end of the document has somewhat passed the document rear side positioning site stipulated on an upstream end of the transparent plate 8), the operation goes to step Q-7, the transfer portion driving means 250 is de-energized, and the timer T7, included in the control means 276, begins to count. In step Q-8, it is judged whether or not the timer T, has counted a predetermined period of time which may be 30 msec. When the timer T7 has counted the predetermined period of time, the operation goes to step Q-9, the transfer driving means 250 is reversibly driven to rotate and drive the conveying belt mechanism 240 in a reverse direction relative to a normal document conveying direction (in FIG. 2, a direction moving from right to left), and the timer T8 included in the control means 276 begins to count timing. Then, in step Q-10, it is judged whether or not the timer T8 has counted a predetermined period of time which may be 100 msec. When the timer T8 has counted the predetermined period of time, the operation goes to step Q-11, the transfer portion driving means 250 is de-energized, and reverse rotation of the conveying belt mechanism 240 is stopped. While the timer T8 counts timing, the document is somewhat transferred to the left in FIG. 2, and the rear end of the document is positioned at a document rear end position site stipulated on the upstream end of the transparent plate 8 when the timer T8 terminates counting of time and the conveying belt mechanism 240 is stopped. Furthermore, in step Q-11, a single showing that a document is positioned at a predetermined site on the transparent plate 8 is sent from the control means 278 of the electrostatographic copying machine 4, and a copying process is started in the electrostatic copying machine 4. Thus, the document secondary conveying is terminated, and the main routine is returned.

Then in step N-17 of the main routine, it is judged whether or not a single document conveying state is selected. When the single document conveying state is selected, the operation goes to step N-18, the electromagnetic solenoid 184 constituting the state changing means is de-energized. Accordingly, the restricting member 152 is returned to an operating position, and the transmission shaft 212 is returned to a connecting position. The separation roller 202 can be connected to the carrying portion driving means 68 via the transmission shaft 212 and the transmission gear 228. Then, the operation goes to step N-19, the electromagnetic solenoid 77 is de-energized and the stopper member 67, shown by a solid line in FIGS. 2 and 3, is returned to its acting position. In step N-20, the flag F2 included in the control means is set at 0. Such flag F2 is set at 0 when there is no document primarily conveyed, and when there is a document existing as being primarily conveyed, the flag F2 is set at 1. When instep N-17 not the single document conveying state but the continuous document conveying state is selected, the operation goes to step N-21, and it is judged whether or not the document detector 145 detects a document, namely whether or not a document to be carried remains on the document placing means 18. When the document detector 145 does not detect a document, the operation goes to step N-19. On the other hand, when the document detector 145 detects the document, the operation goes to step N-22 and the document primary conveying is repeatedly carried out. In step N-23, the above flag F2 is set at 1.

Next, in the step N-24, it is judged whether or not the electrostatic copying machine 4 has received a document exchange signal. When exposure of the document in a copying process to a document positioned on the transparent plate 8 is terminated, the electrostatic copying machine 4 produces the document exchange signal. If such a signal is received by the control means 276, the operation goes to step N-25. In step 25, the transfer

portion driving means **250** is energized, the conveying belt mechanism **240** is driven to rotate in a normal document conveying direction, furthermore the delivery portion driving means **272** is energized to rotate the delivery roller pairs **264** and **266** and the discharge roller pairs **268** and **270**, and thus the document on the transparent plate **8** is conveyed through the document transfer passage **252** and the document delivery passage **254**. In step N-**26**, it is judged whether or not the document detector **274** disposed in the document delivery passage **254** detects the rear end of the document, namely whether or not the rear end of the document conveyed through the document delivery passage **254** passes the document detector **274**. When the rear end of the document passes the document detector **274**, the operation goes to step N-**27**, and it is judged whether or not the flag **F1** is set at 1. When the document delivered through the document delivery passage **254** is the first document and the flag **F1** is set at 0, the operation goes to step N-**28**. In this step N-**28**, the output speed of the delivery portion driving means **272** is set at the first discharge speed **V3-1** which is preferably about 30% to 40% of the usual conveying speed **V1**, and the flag **F1** is set at 1. On the other hand, when the document delivered through the document delivery passage **254** is the second or subsequent document and flag **F1** in step F-**27** is set at 1, the operation goes to step N-**29**. In this step N-**29**, the output speed of the delivery portion driving means **272** is set at the second discharge speed **V3-2** preferably about 20% to 30% of the usual conveying speed **V1** ($0.2\times V1<V3-2<0.3\times V1$). Then, in step N-**30**, it is judged whether or not the document to be delivered is larger than a prescribed size (the size of the document itself will be detected in steps Q-**3**, Q-**4**, and Q-**5** in the above-mentioned document secondary conveying). When the document to be delivered is smaller than a predetermined size (for example, JIS standard B4), the operation goes to step N-**31**, and the timer **T3** included in the control means **276** begins to count timing. In step N-**32**, it is judged whether or not the timer **T3** has counted a predetermined period of time T-S which may be about 400 msec. When the timer **T3** has counted a predetermined period of time, the operation goes to step N-**33**, the delivery portion driving means **272** is de-energized, and the delivery roller pairs **264** and **266** and the discharge roller pairs **268** and **270** stop to rotate. On the other hand, when a document to be delivered has more than a predetermined dimension in step N-**30**, the operation goes to step **34**, and the timer **T4** included in the control means **276** begins to count timing. In step N-**35**, it is judged whether or not the timer **T2** has counted a predetermined period of time T-L which may be about 500 msec. When the timer **T2** has counted a predetermined period of time, the operation goes to step N-**33**. Then, the operation goes to step N-**36**, and it is judged whether or not the flag **F2** is set at 1 or 0. When a document primarily conveyed exists and the flag **F2** is set at 1, the operation returns to step N-**16**, and the secondary conveying of a document is again carried out. When in step N-**36** the flag **F2** is set at 0, the operation goes to step N-**37**, the transfer portion driving means **250** is de-energized, the flag **F1** is set at 0, and the flag **F3** is set at 0. Thereafter, the operation returns to step N-**1**.

With respect to the discharge of the document in the operating sequence mentioned above, the following fact should be worthy of attention. Firstly, when a document to be discharged is relatively large and therefore, receives a relatively large discharge resistance in the state partly discharged into the document receiving means **30** from the document delivery passage **254**, the delivering portion driving means **272** is continued to be energized over a relatively long period of time from the time when the rear end of the document has passed the document detector **274**, and therefore, the discharge roller pairs **268** and **270** continued to be rotated for a relatively long period of time. On the other hand, when the document to be discharged is relatively small and its resistance received in the state partly received onto the document receiving means **30** from the document delivery passage **254** is relatively small, the delivery portion driving means **272** is energized for a relatively short period of time from the time when the rear end of the document has passed the document detector **274**, and therefore, the discharge roller pairs **268** and **270** are driven to rotate over a relatively short period of time. Thus, when the document is relatively small, the delivery portion driving means **272** does not continue to be energized for a long period of time more than necessary (when energization is performed, a waiting time until the next document begins to be carried becomes more than necessary). Accordingly, not only a relatively small document but also a relatively large document can be discharged onto the document receiving means **30** fully well as required.

Secondly, when a document already discharged does not exist on the document receiving means **30**, the document discharged partly onto the document receiving means **30** from the document delivery passage **254** moves on the surface, and therefore, the document receives a relatively large moving resistance. On the other hand, when an already discharged document exists on the document receiving means **30**, the document partly discharged onto the document receiving means **30** from the document delivery passage **254** moves on the surface of the previous document, and the document receives a relatively small moving resistance. In view of this fact, in the above-mentioned automatic document conveying apparatus **2**, the discharge speed **V3-1** of the first document is set at somewhat larger than the discharge speed of the second or subsequent document. Thus, the first document like the second or subsequent document can be fully well discharged at a required position on the document receiving means **30**.

Although not described in the flow chart of FIGS. **10** to **14**, in the illustrated automatic document conveying apparatus **2**, when the document is clogged in any of the document carrying passage **108**, the document transfer passage **252** and the document delivering passage **254**, the clogging of the document is detected, for example, (1) the document detector **82** does not detect the document even when a predetermined period of time elapses from the energization of the carrying clutch **66**; (2) the document detector **90** does not detect the document even when a predetermined period of time elapses from the energization of the delivering clutch **80**; (3) the document detector **82** continues to detect the document even when a predetermined period of time elapses from the detection of the document by the document detector **82**; (4) the document detector **274** does not detect the document even when a predetermined period of time elapses from the energization of the transfer portion driving means **250**; or (5) the document detector **274** continues to detect the document even when a predetermined period of time elapses from the detection of the document by the document detector **274**. When

the clogging of the document is detected, and when the document detector **145** disposed in the upstream end portion of the document carrying passage **108** detects the document, the electromagnetic solenoid **184** constituting a state changing means is energized. Thus, the restriction member **152** is isolated from the feed roller **72**, and the separation roller **202** can be freely rotated. Hence, the document existing in the upstream portion of the document carrying passage **108** can be fully easily taken out without breakage or damage. When the document detector **145** cannot detect the document by taking out the document, the electromagnetic solenoid **184** is de-energized.

In the automatic document conveying apparatus constructed in accordance with the first aspect of the invention, when a single document conveying state is selected in place of a continuous document conveying state, it is possible to fully reliably avoid breakage or damage of a document having a high importance such as an origin of a design.

In the automatic document conveying apparatus constructed in accordance with the second aspect of the invention, irrespective of a number of documents placed in a stacked state on the document placing means **18**, the action of the carrying roller on the documents to be carried is maintained almost constant, and the documents can be carried fully stably.

In the automatic document conveying apparatus constructed in accordance with the third aspect of the invention, when the front portion of the document is curved upwardly or the document has a relatively low stiffness and is large in size, the document can be well conveyed fully well by the action of a synthetic resin guide member.

In the automatic document conveying apparatus constructed in accordance with the fourth aspect of the invention, when the document is relatively small, the energization time of the delivery portion driving means cannot be lengthened more than necessary, and when the document is either relatively small or relatively large, the document can be fully well discharged.

In the automatic document conveying apparatus constructed in accordance with the fifth aspect of the invention, the first document and the second or subsequent document can be discharged onto the document conveying means in nearly the same way, and thus all discharged documents can be fully well stacked.

What we claim is:

1. An automatic document conveying apparatus comprising document placing means, means defining a document carrying passage extending from the document placing means, document sending means for sending a document placed on the document placing means to the document carrying passage, and document overlappingly sending preventing means disposed downstream of the document sending means for preventing two or more documents from being conveyed simultaneously through the document carrying passage, the document overlappingly sending preventing means, including a feed roller and a separation roller disposed in opposition to each other, between which a document is sent by the action of the document sending means, first means for rotating the feed roller in a document conveying direction, second means for rotating the separation roller in a direction opposite to the document conveying directions, means for detachably connecting the separation roller to the second rotating means, state changing means disposed in relation to the separation roller for selectively determining a continuous document conveying state in which the separation roller is connected to the second rotating means and driven to rotate in a direction opposite to the document conveying direction and a single document conveying state in which the separation roller is liberated from the second rotating means and is allowed to be freely rotated in the document conveying direction.

2. The automatic document conveying apparatus of claim **1** further comprising manual input means for controlling the action of the state changing means.

3. The automatic document conveying apparatus of claim **1** further comprising a transmission shaft and a transmission gear interposed between the separation roller and the second rotating means and mounted rotatably and movably in an axial direction between a connecting position, in which the transmission shaft is connected to the transmission gear in the continuous document conveying state, and a separation position, in which the transmission shaft and the transmission gear are separated in the single document conveying state.

4. The automatic document conveying apparatus of claim **3** further comprising elastic biasing means disposed to elastically bias the transmission shaft at the separation position, and wherein the state changing means comprises an electromagnetic solenoid for moving the transmission shaft to the connecting position against the elastic biasing action of the elastic biasing means.

5. The automatic document conveying apparatus of claim **4** further comprising a torque limiter for restricting the transmission torque in the direction opposite to the document conveying direction to a predetermined value, said torque limiter being interposed between the separation roller and the transmission shaft.

6. The automatic document conveying apparatus of claim **1** wherein the document overlappingly sending preventing means further includes a restriction member mounted movably on an upstream side of the separation roller for movement between an acting position at which the restriction member approaches or contacts the feed roller and a non-acting position at which the restriction member is isolated from the feed roller, and wherein the state changing means positions the restriction member at the acting position in the continuous document conveying state and positions the restriction member at the non-acting position in the single document conveying state.

7. The automatic document conveying apparatus of claim **1** further comprising means responsive to the operation of the document conveying being stopped while a document exists in the document overlappingly sending preventing means for causing the state changing means to determine the single document conveying state.

8. The automatic document conveying apparatus of claim **1** further comprising means cooperating with a transparent plate on an image processing machine to define a document transfer passage following the document carrying passage and along the transparent plate of the image processing machine; means defining a document delivery passage extending from the document transfer passage to document receiving means; means responsive to the state changing means determining the continuous document conveying state for conveying a document at a first conveying speed **V1** through at least the document carrying passage and the document transfer passage, and responsive to the state changing means

determining the single document conveying state for conveying the document at a second conveying speed V2, smaller than the first conveying speed V1, through at least the document carrying passage and the document transfer passage.

9. The automatic document conveying apparatus of claim 8 wherein $0.6\times V1<V2<0.8\times V1$.

10. The automatic document conveying apparatus of claim 8 further comprising means responsive to the rear end of the document passing a predetermined position in the document delivery passage for conveying the document at a discharge speed V3 smaller than the first conveying speed V1 and the second conveying speed V2.

11. An automatic document conveying apparatus comprising document placing means, means defining a document carrying passage extending from the document placing means, document sending means for sending a document placed on the document placing means to the document carrying passage, document overlappingly sending preventing means disposed downstream of the document sending means for preventing two or more documents from being conveyed simultaneously through the document carrying passage; the document overlappingly sending preventing means including a feed roller, means for rotating the feed roller in a document conveying direction, a restriction member, means movably mounting the restriction member in relation to the feed roller for movement between an acting position at which the restriction member approaches or contacts the feed roller and a non-acting position at which the restriction member is isolated from the feed roller, and state changing means disposed in relation to the restriction member for selectively determining a continuous document conveying state in which the restriction member is positioned at the acting position and a single document conveying state in which the restriction member is positioned at the non-acting position.

12. The automatic document conveying apparatus of claim 11 further comprising manual input means for controlling the action of the state changing means.

13. The automatic document conveying apparatus of claim 11 wherein the state changing means comprises an electromagnetic solenoid.

14. The automatic document conveying apparatus of claim 11 further comprising means responsive to the operation of the document conveying being stopped while a document exists in the document overlappingly sending preventing means for causing the state changing means to determine the single document conveying state.

15. The automatic document conveying apparatus of claim 11 further comprising means cooperating with a transparent plate on an image processing machine to define a document transfer passage following the document carrying passage and along the transparent plate of the image processing machine; means defining a document delivery passage extending from the document transfer passage to document receiving means; means responsive to the state changing means determining the continuous document conveying state for conveying a document at a first conveying speed V1 through at least the document carrying passage and the document transfer passage, and responsive to the state changing means determining the single document conveying state for conveying the document at a second conveying speed V2, smaller than the first conveying speed V1, through at least the document carrying passage and the document transfer passage.

16. The automatic document conveying apparatus of claim 15 wherein $0.6\times V1<V2<0.8\times V1$.

17. The automatic-document conveying apparatus of claim 16 further comprising means responsive to the rear end of the document passing a predetermined position in the document delivery passage for conveying the document at a discharge speed V3 smaller than the first conveying speed V1 and the second conveying speed V2.

18. An automatic document conveying apparatus comprising document placing means, means defining a document carrying passage extending from the document placing means, document sending means for sending a document placed on the document placing means to the document carrying passage, the document sending means including a carrying roller formed of a relatively soft material and means for driving the carrying roller to rotate in a document carrying direction, a pressing member formed of a relatively rigid material and disposed in opposition to the carrying roller, biasing means for biasing the pressing member toward the peripheral surface of the carrying roller such that the front end portion of a document placed on the document placing means is interposed between the carrying roller and the pressing member, and collar members formed of a relatively rigid material and concentrically and rotatably mounted on both sides of the carrying roller, the outer diameter of the collar members being substantially the same as, or somewhat smaller than, the outer diameter of the carrying roller, and both end portions of the pressing member being positioned in opposition to the collar members.

19. The automatic document conveying apparatus of claim 18 wherein the collar members are formed of a synthetic resin and the carrying roller is formed of a rubber.

20. The automatic document conveying apparatus of claim 18 wherein the biasing means comprises an electromagnetic solenoid, and means for energizing the electromagnetic solenoid to bias the pressing member against the peripheral surfaces of the carrying roller and the collar members, the pressing member being isolated from the carrying roller and the collar members when the electromagnetic solenoid is de-energized.

21. The automatic document conveying apparatus of claim 18 wherein the pressing member is disposed above the carrying roller; and further comprising document overlappingly sending preventing means disposed downstream of the document sending means for preventing two or more documents from being conveyed simultaneously through the document carrying passage, the overlappingly sending preventing means including:

a lower side feed roller and an upper side separation roller disposed in opposition to each other, between which a document is sent by the action of the document sending means,

means for driving the feed roller to rotate in a document conveying direction,

means for driving the separation roller to rotate in a direction opposite to the document conveying direction, and

a guide member formed of a synthetic resin film, disposed on both sides of the carrying roller, the collar members, the pressing member, the feed roller and the separation roller, and extending from the upstream side of the carrying roller toward the

feed roller and the separation roller and from above the carrying roller to below the nip site between the feed roller and the separation roller.

22. The automatic document conveying apparatus of claim **21** wherein the document overlappingly sending preventing means further includes a restriction member approaching or contacting the feed roller on the upstream side of the separation roller, and wherein the guiding member extends below the forward end of the restriction member.

23. An automatic document conveying apparatus comprising document placing means, means defining a document carrying passage extending from the document placing means, document sending means for sending a document placed on the document placing means to the document carrying passage, document overlappingly sending preventing means disposed downstream of the document sending means for preventing two or more document from being conveyed simultaneously through the document carrying passage, the document sending means including a carrying roller formed of a relatively soft material and means for driving the carrying roller to rotate in a document carrying direction, a pressing member formed of a relatively rigid material and disposed opposite to the carrying roller, biasing means for biasing the pressing member toward the peripheral surface of the carrying roller such that the front portion of a document placed on the document placing means is interposed between the carrying roller and the pressing member, the document overlappingly sending preventing means including:

a lower side feed roller and an upper side separation roller disposed opposite to each other, between which a document is sent by the action of the document sending means,

means for driving the feed roller to rotate in a document conveying direction, and

means for driving the separation roller to rotate in a direction opposite to the document conveying direction;

said automatic document conveying apparatus further comprising a guide member formed of a synthetic resin film, disposed on both sides of the carrying roller, the pressing member, the feed roller and the separation roller, and extending from the upstream side of the carrying roller toward the feed roller and the separation roller and from above the carrying roller to below the nip site of the feed roller and the separation roller.

24. The automatic document conveying apparatus of claim **23** wherein the document overlappingly sending preventing means further includes a restriction members approaching or contacting the feed roller upstream of the separation roller, and wherein the guide member extends below the forward end of the restriction member.

25. An automatic document conveying apparatus comprising document placing means, document receiving means; means defining a document conveying passage including a document carrying passage extending from the document placing means, a document transfer passage following the document carrying passage and adapted to extend along a transparent plate of an image processing machine, and a document delivery passage extending from the document transfer passage to the document receiving means; document conveying means including document carrying means for conveying a document through the document carrying passage, document transfer means for transferring a document through the document transfer passage, and document delivering means for delivering a document through the document delivery passage; carried document detecting means for detecting a document carried through the document carrying passage; delivered document detecting means for detecting a document delivered through the document delivery passage; operation control means normally causing the document delivering means to deliver the document at a delivery speed **V1**, and responsive to the delivered document detecting means detecting the rear end of the document for decreasing the document delivery speed by the document delivering means to a discharge speed **V3** smaller than the delivery speed **V1**, responsive to the passage of a predetermined period of time T for stopping the operation of the document delivering means, responsive to the document detected by the carried document detecting means being larger than a first predetermined size for adjusting the predetermined period of time to be T-L, and responsive to the document detected by the carried document detecting means being smaller than a second predetermined size for adjusting the predetermined period of time to be T-S, where the predetermined period of time T-L is longer than the predetermined period of time T-S.

26. The automatic document conveying apparatus of claim **25** wherein the predetermined period of time T-L is longer than the predetermined period of time T-S by 70 to 130 msec.

27. The automatic document conveying apparatus of claim **25** wherein the operation control means is responsive to the document detected by the delivered document detecting means from the beginning of the operation being the first document, for adjusting the discharge speed to be **V3-1**, and is responsive to the document detected by the delivered document detecting means from the beginning of the operation being the second or a subsequent document, for adjusting the discharge speed to be **V3-2**, where the discharge speed **V3-1** is larger than the discharge speed **V3-2**.

28. The automatic document conveying apparatus of claim **25** wherein $0.3\times V1 \leqq V3-1 \leqq 0.4\times V1$ and $0.2\times V1 \leqq V3-2 \leqq 0.3\times V1$.

29. An automatic document conveying apparatus comprising document placing means, document receiving means, means defining a document conveying passage including a document carrying passage extending from the document placing means, a document transfer passage following the document carrying passage and adapted to extend along a transparent plate of an image processing machine, and a document delivery passage extending from the document transfer passage to the document receiving means; document conveying means including document carrying means for conveying a document through the document carrying passage, document transfer means for transferring the document through the document transfer passage, and document delivering means for delivering the document through the document passage; carried document detecting means for detecting a document carried through the document carrying passage; delivered document detecting means for detecting a document delivered through the document delivery passage; operation control means normally causing the document delivery means to deliver the document at a delivering speed **V1**, and responsive to the delivered document detecting means detecting the rear end of the document for decreasing

the delivering speed by the document delivering means to a delivering speed V3 smaller than the delivering speed V1, responsive to the lapse of a predetermined period of time T for stopping the operation of the document delivery means, responsive to the document detected by the delivered document detecting means from the beginning of the operation being the first document, for adjusting the discharge speed to be V3-1, and responsive to the document detected by the delivered document detecting means from the beginning of the operation being the second or a subsequent document, for adjusting the discharge speed to be V3-2, where the discharge speed V3-1 is larger than the discharge speed V3-2.

30. The automatic document conveying apparatus of claim 29 wherein $0.3\times V1 \leqq V3-1 \leqq 0.4\times V1$ and $0.2\times V1 \leqq V3-2 \leqq 0.3\times V1$.

31. The automatic document conveying apparatus comprising document placing means; document receiving means; means defining a document conveying passage including a document carrying passage extending from the document placing means, a document transfer passage following the document carrying passage and adapted to extend along a transparent plate of an image processing machine, and a document delivery passage extending from the document transfer passage to the document receiving means; document conveying means including document carrying means for conveying a document through the document carrying passage, document transfer means for conveying the document through the document transfer passage, and document delivering means for discharging the document through the document delivery passage; state changing means for selectively determining a continuous document conveying state or a single document conveying state; and control means responsive to the state changing means determining the continuous document conveying state for causing the document carrying means and the document transfer means to convey the document at a conveying speed V1 at least through the document carrying passage and the document transfer passage, and responsive to the state changing means determining the single document conveying state for causing the document carrying means and the document transfer means to convey the document through at least the document carrying passage and the document transfer passage at a conveying speed V2 than the conveying speed V1.

32. The automatic document conveying apparatus of claim 31 wherein $0.6\times V1 < V2 < 0.8\times V1$.

33. The automatic document conveying apparatus of claim 31 or 32 further comprising manual input means for controlling the operation of the state changing means.

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